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AN OPPORTUNITY FOR CENTRAL STATION MEN.

The convention of the Northwestern Electrical Association next month offers advantages in the way of the direct acquisition of knowledge from the best sources unparalleled in conventions. In the ordinary meeting of this kind papers are read, taking up most of the time of the sessions. Anyone can take the reprints of these papers and read them at his leisure, getting practically the full benefit of all the proceedings. In this convention, however, during the time spent on shipboard, the attendants will have unparalleled opportunities for meeting the leading men in the profession personally, asking them questions and discussing with them the lines of work in which they are prominent. This personal questioning and off hand discussion gives opportunities for clearing up points of difficulty and doubt as no written paper does. Anyone who does not attend the convention will miss this feature entirely, as these valuable little personal encounters cannot, of course, be reported.

Of the gentlemen specially invited by the association and the cities to attend the convention, Prof. Elihu Thomson and Messrs. T. A. Edison, F. J. Sprague and J. J. Wood have already accepted. Anyone who does not long to ask Mr. Edison about magnetic ore separation, Mr. Sprague about the multiple-unit system, or the others about their specialties, must be well satisfied with his own knowledge.

THE HEATING OF FEED WATER BY LIVE STEAM.

That the heating of the feed water supplied to a boiler by live steam taken from the same boiler results in an increased economy has long been known and made use of, although generally considered paradoxical. The London "Electrician" attempts to find an explanation for it in the fact that the heat transmitted through the boiler plates is given to the water at a higher temperature if the latter enters the boiler at the temperature of the steam than if at some lower temperature. This explanation is based on the thermodynamic principle that a given amount of heat is more useful if absorbed at a high temperature than if at a lower one. The originator of this theory seems to have overlooked the fact that it requires a certain number of British thermal units to raise a certain amount of water to the boiler temperature and evaporate it into steam at any given pressure, whether those B. T. U. are transmitted through the plates partially at one temperature and partially at another, or entirely at the higher, and the same amount of energy is available from the steam in either case. In fact, the lower temperature on the tube plates would seem to be, from thermodynamic considerations, the better, as it would to a slight extent further reduce the waste of heat in the escaping flue gases.

Another and more probable theory, advanced by Professor Unwin, is that water in the act of boiling is capable of absorbing heat much more rapidly than when merely changing temperature, due perhaps to the increased circulation or the enormously greater absorption of a given volume or both.

SOME RIGHTS OF THE PUBLIC.

Quasi-public corporations, such as those operating electric lighting or street railway systems, depend for their very existence on franchises or rights to the use of public property granted by the communities within whose bounds they operate. These franchises and rights are often of great value, and rarely, especially in the case of large cities, is any adequate direct return made to the grantor. This involves at least a moral obligation that the corporation should give fair service at fair prices. This point is well brought out in the address recently made by Mr. A. E. Lang, and reproduced in part in another column. Mr. Lang also points out that such corporations should not keep the important features of their business secret and the publication of a complete stockholders' report of the business of such corporations would undoubtedly go far toward allaying the widespread public discontent often existing.

The consumer does not realize the enormous disadvantages under which companies using electrical apparatus often work. The constant improvements in apparatus necessitate constant renewals with their attendant additions to the interest account, or the running of old machinery with its serious losses and maintenance costs. The public is, however, made acquainted with the other side of the question, namely, the cost of service with a brand new up-to-date plant, no good money being thrown in the scrap heap, and often with an absurdly low cost of installation and operation figured out by interested promoters of rival systems, either private or municipal. The frank and honest disclosure of the actual state of the business of such corporations would, in case the business were fairly conducted, lead to a much less distrustful and more sympathetic attitude on the part of the public, and in case the business were not honestly conducted, and unfair charges and unreasonable profits were the result, the company deserves the treatment which would result.

Many companies refuse to make public the main features of their accounts, on the score that it is likely to injure their business by giving their competitors an unfair advantage. A notable example of a successful business managed in this public way is given by the Edison Electric Illuminating Company, of New York, which publishes each year an annual report of the board of directors to the stockholders, giving every important detail of the earnings, expenses, number of customers, means of improving the service and all such information, which should be, if the argument of the advocates of secrecy is correct, sufficient to enable its rivals to promptly destroy its enormous business.

Too many concerns of this kind are run upon the principle that the company has and should exercise the right to make all the profits it possibly can in the least time. The franchises and the use of the public ways are granted to such companies generally on the ground that they are for the interest of the public. They are given, therefore, as an accommodation to the public and not as a privilege or gift to the company. Upon this theory and looked at from the standpoint of the commonwealth, if the operation of the system is profitable beyond a moderate return upon the capital actually invested it is just to require that the rates be reduced or the service improved. This is the justification of the demand for municipal ownership, and unfortunately it is too often a requirement that is properly asked and promptly refused. The attempt is often made to levy a tax upon the business by a rental, toll or percentage of receipts or profits. If this direct return is enforced the franchise is practically sold or rented for it, and in order to obtain the highest return from this sale the community may properly grant the company an absolute and exclusive privilege for at least a limited period, the possibility of its revocation or direct competition obviously making the franchise of much less value.

COMPOUND WOUND MOTORS.

In the early days of power distribution by direct-current electric motors a compound winding was used by which the field excitation was reduced as the speed increased, thereby maintaining a closer speed regulation on constant potential than is attainable with a simple shunt motor. This practice has gone quite out of use, the speed regulation of the shunt machine being sufficiently close for all practical purposes. On the other hand, the compound winding has come into favor, so connected that the field excitation increases with the increase of load, thereby giving greater torque with the same armature current, lower speed and increased field excitation at the time when it is most needed to reduce the field distortion. These features are of value in many applications of a motor, such particularly as crane and elevator work, where close speed regulation is of no advantage, and in fact the reduction of speed with the increase of load is preferable. This compounding has of late been carried further and further, at least one machine now being made for elevator work with all the resistance of the starting rheostat mounted upon the field coils to give a greatly overcharged field at low speeds.

There is a danger in this that does not seem to have been generally appreciated. With machines that are reversed, working both ways and with loads that may be negative, or in other words, loads that may under certain conditions tend to drive the machine in the same direction that the motor is driving it, thus turning the motor into a generator, the series winding may involve serious trouble. While, on a motor load, the series coils add to the excitation of the shunt coil, if the load reverses and tends to drive the motor as a generator, the current in the series fields neutralizes in part the excitation of the shunt fields, weakening the magnetization and tending to speed the motor up and make it run away. In extreme cases the series windings may completely demagnetize the fields, leaving the armature to act as a short circuit across the lines. In machines that invariably absorb power when running in one direction and give it out when running in the other, such as crane hoists or under-counterweighted elevators, this danger may be provided against by reversing the connections of the series field simultaneously with the reversal of the armature connections for changing the direction of motion. In that case when the load comes down the current generated in the armature tends to increase the field excitation, just as when the load is lifted the current delivered to the armature increases the excitation, but with under-counterweighed elevators or any load where the torque may reverse when running in either direction, the series field is a decided element of danger.

Features of the Convention of the Northwestern Electrical Association.

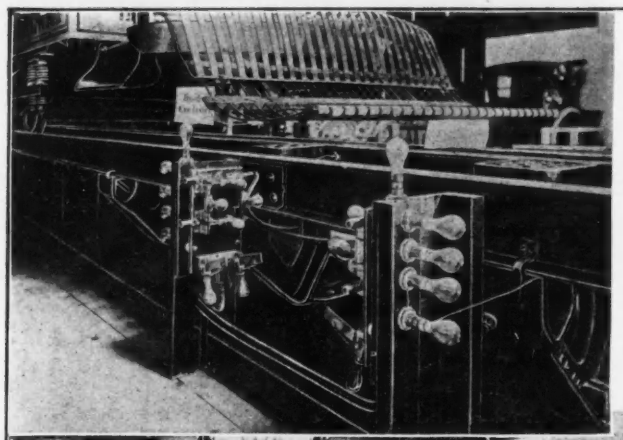
During the sessions held on shipboard en route from Chicago to Duluth it has been decided to have, instead of elaborate papers, a series of topics for discussion and also a question box. The topics chosen include some of considerable value to central station men, and it is hoped that a number of men prominent in the work falling under the various topics will be present to take part. Among these topics are the following: Electrical Measuring Instruments; Lightning Arresters; Transformers; Meters; Arc Lamps; Incandescent Lamps, Single-Phase Motors; Engines; Boiler Furnaces; Mechanical Drafts. Invitations have been issued by the association and by the cities of Duluth and Superior to the following gentlemen to be guests during the convention: Thomas A. Edison, Nikola Tesla, J. J. Wood, Charles F. Brush, Elihu Thomson and William Stanley, Jr. Mr. J. M. Hill and Mr. Thomas R. Mercein have lately visited Eastern cities, making preparations for the convention.

The Conduit Electric Road at the New York Exhibition.

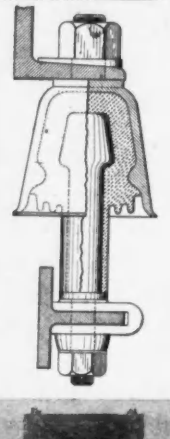
One of the most interesting exhibits at Madison Square Garden is the completely equipped section of a conduit electric road, with a car in place and in running order. The underground construction is quite similar to that installed on the lines of the Metropolitan Street Railway Company in New York City. The yokes, which are spaced 5 feet apart, are all standard, no special hand-hole yokes being used, and weigh 550 pounds each. The yokes are provided with lugs to hold the boards which form the outside false work of the concrete conduit walls. The method of fastening the rails to the yokes is improved by chipping the gauge-determining lugs on the yokes before they leave the works, so that the rails are brought to gauge by simply bolting them to the yokes without the use of any wedge-shaped shims. The holding-down bolts pass diagonally through a V-shaped box in the yoke and are set up against the under side of this box.

The conductor rails are of tee section, supported every 15 feet by two Z-shaped slot rails just below the slot. The body of the plow is made of fibre and the contacts are cast iron shoes supported by stiff helically coiled steel springs, the shoes being further connected to the plates by copper braid "pig tails." The plow is fused on both sides.

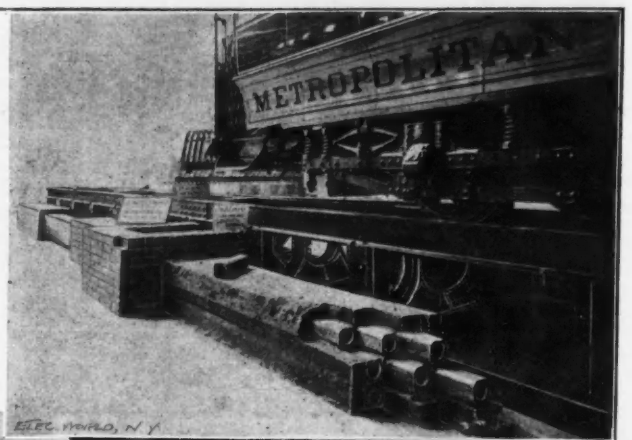
The exhibit is quite comprehensive, so far as the makers of the apparatus are concerned, the car being built by the John Stephenson Company, equipped with electric heaters of the Consolidated Car Heating Company, and fare registers by the Sterling Supply & Manufacturing Company, fitted with Peckham trucks. Walker motors and controllers and Providence feeders. The 110-pound rails were supplied by the Johnson Company, and the yokes and electrical transmission system by the Walker Company, under the patents of the Love Electric Traction Company. The section is shown completely equipped with a short line of lead-covered feeders supplied by the John A. Roebling's Sons Company, threaded in conduits made by the H. B. Camp Company, the J. G. White Company figuring as contractors for the installation of complete equipments.



TESTING HATCH.
TRACK CONSTRUCTION, UNPAVED.



INSULATOR
PLOW.



FEEDER CONDUITS.
TRACK CONSTRUCTION, PAVED.

insulators hung direct from the foot of the slot rail. It will be remembered that in the New York City work the insulator was a large porcelain inverted cup screwed and cemented into a cap and having a pin screwed and cemented into it, the whole being offset to one side so that the weight of the conductor rail gave a considerable bending moment in the insulator. The insulator of the new system is made up of composition moulded under pressure inside the cast bell and about the pin. As the centre of gravity of the conductor rail is very nearly under the centre of the insulator there is but small bending moment.

In one of the illustrations there are shown the switching arrangements at the testing hatches or man holes. It is planned to install these every 500 feet or so along the trackway with two small panels, as shown, each bearing six knife switches. One of these panels is positive and the other negative. The four upper terminal lugs on each panel feed respectively the four rails running from the testing hatch in the two directions under the two tracks. The lower snap switches introduce the current at two corners of the rectangle and, by pulling out any one or more of the blades at two adjacent hatches, any one or more of the rails can be cut out for testing or emergency purposes.

The plow is arranged for ready removal, and is also supported from the car in such a way that in case of derailment or misplaced switch the plow can be readily carried away from its mounting on the car. It carries a pair of wheels or rollers running between the

Probable Results of the Electric Service on the South Side Elevated Railroad, Chicago.

The managers of the Alley elevated road in Chicago, judging from the limited experience already obtained with a few trains interspersed with the steam trains, report that as soon as the latter are entirely replaced they will be able to reduce the schedule time from thirty-eight to thirty minutes, and save in transportation wages alone more than the total depreciation. They also estimate that they can make the same car mileage with 15 per cent. fewer cars and a considerable reduction on the strains on the structure, and in addition to this they have already noticed an increase in the receipts, due to the improved quality of the service.

Motor-Driven Longshoremen.

A traveling gangway constructed somewhat on the principle of the oft-proposed traveling stairway was described in a late issue of the "Railroad Gazette." This freight gangway is in use by the Metropolitan Steamship Company at the India Wharf, Boston. The freight handlers wheel their trucks on to one end of the continuously moving gangway, and the men and trucks are delivered, without further muscular effort, at the other end. The gangway is driven by a 7½-hp motor. The equipment was installed by the Link Belt Engineering Company.

On a Simple Approximate Method of Determining the Harmonic Components of a Graphically Given Complex Harmonic Wave.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

The following method, which seems to be new, for arriving at the amplitudes of the harmonic components in an alternating-current wave, has the advantage of being readily remembered, of being capable of execution without the aid of any apparatus, and of requiring practically no mathematical training. On the other hand, however, it is not a strictly accurate method, and may be regarded as serviceable to engineers rather than to mathematicians.

The method is based upon the following proposition:

Let w, an odd number of semi-wave lengths of a sinusoid, be divided by straight lines perpendicular to the zero line, into p strips of equal width. Then, if p is a number greater than unity and prime to w, the difference between the sums of the areas in alternate strips is zero.

Thus, in Fig. 1, five semi-wave lengths of the sinusoid comprised between the verticals $A\ A$ and $B\ B$, are divided into nine strips of equal width ($w = 5$, $p = 9$). Then the sum of the shaded areas of strips 1, 3, 5, 7 and 9 is equal to the sum of the unshaded areas 2, 4, 6 and 8; or, denoting by s, the area of the curve in a given section

$$(s_1 + s_3 + s_5 + s_7 + s_9) - (s_2 + s_4 + s_6 + s_8) = 0.$$

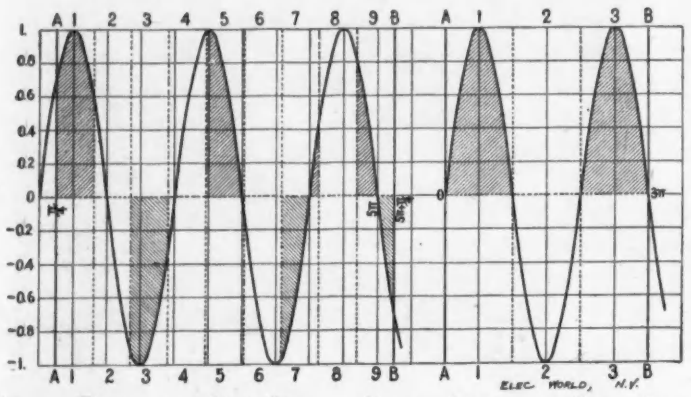


Fig. 1.—Division of Five Semi-Waves into Nine Strips. Summation Difference Zero.

Fig. 2.—Division of Three Semi-Waves into Three Strips Commencing at Zero. Summation Difference Three Semi-Waves Area.

In the summation all areas lying above the zero line are to be treated as positive, and all areas beneath the line as negative. The equation may be written

Sum of odd strips — sum of even strips = 0.

In the case of Fig. 1,

$s_1 = + 1.5263$		$s_2 =$	$- 0.3961$
$s_3 =$	$- 1.3884$	$s_4 = + 0.8787$	
$s_5 = + 1.0834$		$s_6 =$	$- 1.2551$
$s_7 =$	$- 0.6474$	$s_8 = + 1.4799$	
$s_9 = + 0.1335$			
$+ 2.7432$	$- 2.0358 = 0.7074$	$+2.3586$	$- 1.6512 = 0.7074$

so that $(s_1 + s_3 + s_5 + s_7 + s_9) - (s_2 + s_4 + s_6 + s_8) = 0$

or the summation difference is zero.

The same result will be true if three semi-wave lengths are divided into five, seven, or eleven strips, etc.

If, however, $p = w$, as in Fig. 2, and the strips commence at the zero line; then,

sum of odd strips — sum of even strips = p times area of one semi-wave.

Thus, in Fig. 2, three semi-wave lengths, commencing at zero, are divided into three strips of equal width. The areas are:

$s_1 = 1$ $\quad s_2 = -1$ $\quad s_3 = 1$

$(s_1 + s_3) = 2$ $\quad s_2 = -1$

$(s_1 + s_3) - (s_2) = 3 =$ $\quad 3 \times$ area of 1 semi-wave.

With the aid of these propositions we form the following rule:

Let a given graphical wave corresponding to one alternation and commencing at the zero line be represented by the expression

$$A_1 \sin \alpha + A_3 \sin 3\alpha + A_5 \sin 5\alpha + A_7 \sin 7\alpha + \text{etc.}$$
$$+ B_1 \cos \alpha + B_3 \cos 3\alpha + B_5 \cos 5\alpha + B_7 \cos 7\alpha + \text{etc.}$$

To find any given coefficient, such as A_3, in the sine series, divide the curve into three equal strips, commencing at the zero point, and find the summation difference S, by planimeter, or otherwise. Then $A_3 = \frac{\pi S}{L}$ where L, is the length of the given complete wave or the length of two of the given semi-waves.

Again, to find any coefficient in the cosine series, such as B_5, divide the semi-wave into five strips, commencing at a point half a quintuple-frequency semi-wave length from the zero point. Find the summation difference and denote it by S. Then

$$B_5 = \frac{\pi S}{L}$$

It is not necessary to employ a planimeter in order to determine the areas. For nearly all practical purposes it suffices to draw the given curves on closely ruled squared paper and to find the areas by counting the little squares included in the various strips.

Fig. 3, shows an application of the method. A fundamental sinusoid $F = 50 \sin \alpha$ is combined with a triple frequency harmonic $T = 25 \sin (3\alpha - 60°)$, and with a quintuple frequency harmonic $Q = 10 \sin 5\alpha$. The resultant complex harmonic curve is given at R.

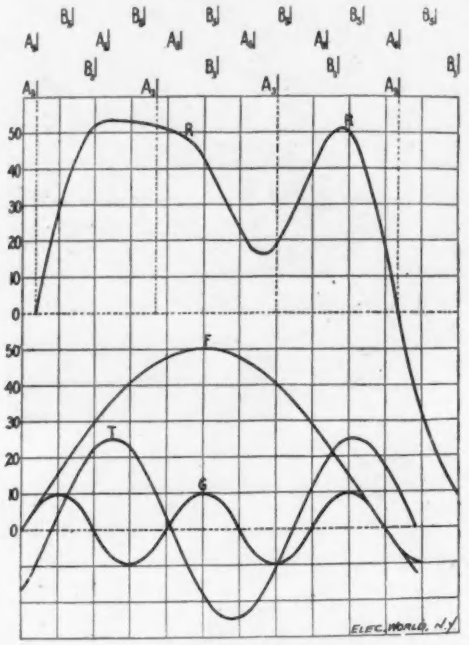


Fig. 3.—Synthesis and Analysis of a Complete Wave.

Suppose that it is required to determine the harmonics in R, and that the amplitude of the triple frequency harmonic A, is first sought for.

Draw lines A_3, A_3, A_3, A_3, as shown, and count the little squares in the first, second and third strips. These are approximately 1412.9; 1155 and 1163.5, respectively.

$\therefore\ s_1 + s_2 = 2576.4$ $\quad s_2 = 1155$; so that $(s_1 + s_3) - s_2 = 1423.4$. This is three times the area of one sine semi-wave of the triple frequency To find the amplitude

$$A_3 = \frac{\pi \times 1423.4}{200},$$

since 200 is the length of two semi-waves or one cycle of the given wave. Thus $A_3 = + 22.33$. Similarly to find B_3, the cosine component of triple frequency, draw lines perpendicular to the zero lines through B_3, B_3, B_3, B_3. The areas of the strips included will be 1660.3; 972.6; 33.5. Taking the second from the sum of the first and third the summation difference is + 721.2 and

$$B_3 = \frac{\pi \times 721.2}{200} = + 11.33.$$

The resultant triple frequency, without respect to phase, is, therefore, $\sqrt{(22.33)^2 + (11.33)^2} = 25.04$

which is very nearly correct, since 25 is the given amplitude of T.

In the same way it will be found by drawing lines first through A_5, A_5, and then through B_5, B_5, that

$$A_5 = + 8.76$$
$$B_5 = - 5.06$$

the resultant of which is 10.12, approximately correct. The harmonic series of the resultant curve is therefore

$$+ 22.33 \sin 3\alpha + 8.76 \sin 5\alpha$$
$$+ 11.33 \cos 3\alpha - 5.06 \cos 5\alpha$$

In this manner any given harmonic may be found in its turn, while the amplitude of the fundamental A and B, may be found, if

desired, by applying the computed harmonics to the resultant curve.

In the case of Fig. 3, if the resultant curve were correctly plotted, the harmonic amplitudes could be determined with any desired degree of accuracy, because there are no harmonics present above that of quintuple frequency. Where, however, a great number of harmonics are present the results obtained are slightly vitiated by the higher harmonics. This is for the reason that if w, the number of waves is an odd multiple of p, the number of strips, the summation difference is not zero, but p times the area of one semi-wave Thus if nine semi-waves be divided into three strips, commencing with the zero point, the summation difference will be the area of three semi-waves. Consequently, when any given summation difference is obtained, say that of A_3, it will contain the area of one wave of the frequency multiples 3 (1, 3, 5, 7, etc.), or one wave of nine times frequency, one wave of fifteen times, one wave of twenty-one times, and so on. In practice, the amplitudes of harmonics above the fifth may be neglected, so that the error is usually insignificant, and for practical purposes the method may be regarded as fairly reliable. As a test of the degree of accuracy possessed by the method we may consider two cases of simple wave forms which do not readily

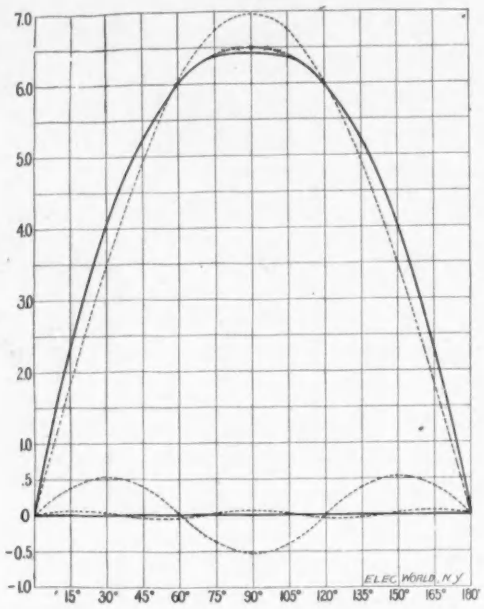


FIG. 4.—ANALYSIS OF HEAVY CURVE INTO 6.98 SIN ωt + 0.526 SIN 3 ωt + 0.053 SIN 5 ωt.

present themselves in practice, but of which the harmonics are readily deducible.

First, the triangular wave form, or saw-tooth form.

The analysis of this type of wave goes as far as the septuple frequency harmonic

$$0.81057 \sin \alpha - 0.090063 \sin 3\alpha + 0.032423 \sin 5\alpha - 0.016542 \sin 7\alpha,$$

and by this method it is

$$0.7854 \sin \alpha - 0.087266 \sin 3\alpha + 0.031416 \sin 5\alpha - 0.016029 \sin 7\alpha.$$

It so happens that in this case the numerical error in each frequency is the same; that is to say, the method gives harmonics which are all 3.1 per cent. too small.

Second, the case of a semicircular wave which as far as the triple harmonic may be written*

$$1.781 \sin \alpha + 0.2948 \sin 3\alpha + 0.1332 \sin 5\alpha.$$

by this method gives

$$1.800 \sin \alpha + 0.324 \sin 3\alpha + 0.146 \sin 5\alpha.$$

The discrepancies in these cases are not of serious consequence for practical purposes.

As an example of an actual wave analyzed by this method we may take the case of the E. M. F. wave generated by the first large alternator at Niagara Falls, according to the curve given on page 298 of "Cassier's Magazine," July, 1895. This wave is represented by the heavy curve in Fig. 4. The dotted lines give the analysis as far as the quintuple frequency harmonic, as follows:

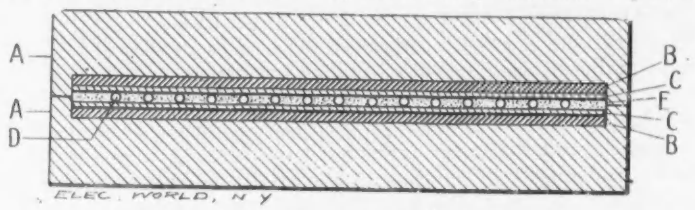
$$6.98 \sin \alpha + 0.526 \sin 3\alpha + 0.053 \sin 5\alpha$$

The sum of these three harmonic waves coincides almost exactly with the heavy wave to be analyzed, except at the vertex of the curve, where the small discrepancy is marked off.

Enamel Rheostats.

The general object of the enamel rheostat is the provision of an increased heat-radiating surface over and above that of the conducting wire or strip of the resistance proper. The whole object of a rheostat, as a rule, is the absorption of electrical energy and its delivery to the surrounding medium—generally the air—as heat, and any means by which the radiating surface of a given piece of wire can be increased allows the energy transformed in that wire from electricity to heat to be correspondingly increased without increasing the rise in temperature. In what are known as enamel rheostats the conducting or what might better be called the resisting wire is adhesively attached by means of a vitreous material to some comparatively large body, generally a cast-iron plate, in such a way that the conductor is firmly held in close proximity to the plate, insulated therefrom electrically, but intimately connected thereto thermally.

It has been found that if a cast-iron plate be employed as a support or radiating surface, the insulating layer should not be very glassy, as it is difficult to prepare such a coating on cast-iron without pin holes, blisters, etc. Another difficulty is that with a very vitreous and consequently brittle material, sudden large currents may heat



CROSS-SECTION OF IMPROVED ENAMEL RHEOSTAT.

the conducting wires so much more rapidly than they do the other parts that the glaze or enamel will be broken by the expansion of the conductor. By the admixture of some powdered material, such as silica, clay or magnesia, a coating can be obtained which is hard, adhesive, free from the disadvantages mentioned, but incapable of resisting high E. M. Fs., which tend to pierce the thin layer of insulation between the conductor and the plates.

With bases other than cast iron the former difficulty does not seem to occur, and with low E. M. Fs. the combination with powdered materials is unobjectionable.

In still another form of enamel rheostat the conductor is separated from the radiating plate by a layer of more flexible material, such as Portland cement. This has a comparatively low insulation resistance and therefore a greater thickness is necessary between the wire and the plate, this thick wall seriously interfering with the transmission of heat from one part to the other. Portland cement, being porous, is also affected by moisture, as glazed materials are not.

These difficulties encountered in the construction of enamel rheostats are recounted in the specifications of patent No. 603,063, dated April 26, 1898, granted to Mr. H. Ward Leonard, for a construction intended to overcome them. A cross section showing the details of this construction is reproduced herewith. In this A A represent two cast-iron plates between which the heat is generated. B is a coating on such plate of partially vitrified material, preferably applied in the form of a powder, either dry or mixed with a fluid to a form of paste, cement or paint and afterward heated until it becomes a coherent layer of solid material. This is rendered impervious to moisture by a thin vitrified coating or glaze, C. The conductor, D, is placed between these two glazed coats, C C, and is held in position by a non-vitrified layer E, which may be cement, clay, asbestos, spun glass, mica, or any powdered infusible material.

*The harmonic series, which represents a semicircular wave, is given by the following infinite series, each term of which contains an infinite series.

$$\frac{\pi^2}{4}\left\{\sin\alpha\sum_{n=0}^{n=\infty}\frac{(-1)^{n+1}}{n!\,(n-1)!}\left(\frac{\pi}{4}\right)^{2(n-1)} - \sin 3\alpha\sum_{n=0}^{n=\infty}\frac{(-1)^{n+1}}{n!\,(n-1)!}\left(\frac{3\pi}{4}\right)^{2(n-1)} + \sin 5\alpha\sum_{n=0}^{n=\infty}\frac{(-1)^{n+1}}{n!\,(n-1)!}\left(\frac{5\pi}{4}\right)^{2(n-1)} - \text{etc.}\right.$$

The Real Meaning of Incandescent Lamp Efficiency.

BY FRANCIS W. WILLCOX.

An amusing story is told of a lamp purchaser who, when he received a package of lamps and the shipping ticket announcing "fifty lamps, 16 candle power, 110 volts, 3.6 watts," carefully examined the package, and wrote to the lamp company: "The lamps have come but the 'watts' mentioned were not in the package."

This happened, of course, in the early days of electric lighting. Hardly any user of lamps to-day does not understand that the term "watts per candle" expresses the economy or efficiency of an incandescent lamp. Almost everyone knows that the term efficiency is used to denote the power per unit of illumination consumed by the lamp at the beginning of its life, and that it is generally convenient and practical to express it in watts per candle. For example, a 16-cp lamp consuming a total of 50 watts is designated as having an efficiency of 3.1 watts per candle. A 3.1-watt lamp is said to be of higher efficiency than a 3.5-watt lamp, and contrarily a 3.5-watt lamp is of lower efficiency than a 3.1-watt lamp.

This is the generally understood meaning of the term "efficiency" and forms the present accepted basis of rating incandescent lamps. Such a basis of rating is proper and acceptable as a classification of lamps, just as candle power and voltage are. It is not, however, a basis for either rating the value or determining the quality of lamps, as it is quite generally and wrongly understood to be.

In the early days of lamp manufacture the problem was to produce a lamp that would live. Length of life was the first and chief feature sought for and the aim of lamp manufacturers was the production of a lamp that would consume the least power and yet live. These early lamps consumed 5 and 6 watts per candle, but the art has advanced until a 3.1-watt lamp has finally been developed.

By taking the watt per candle rating only at the start, lamps were after much difficulty produced consuming not to exceed 3.1 watts per candle, and giving a fair average life. The difficulties of lamp manufacture at that time necessitated overlooking what the candle power, and resulting watts per candle might be after starting. The production of a lamp that would live and showed an initial efficiency of 3.1 watts was a great achievement and the best the art could then accomplish, but it is necessary to understand just what character of lamp it was. The 3-watt lamp was a 3-watt lamp only temporarily. Like a shooting star, it appeared but for a short time at the high point of its orbit, and immediately thereafter fell rapidly down the scale of candle power and watts per candle to join company with its 5 and 6-watt progenitors.

Such lamps gave a low average light during their life, but they were hailed with great acclaim for the saving in power per lamp unit effected. In this way efficiency at starting, or initial efficiency, came to be accepted as a basis for determining the relative value of different lamps, the lamp having the highest efficiency (least watts per candle) with fair average life being judged the best lamp.

With the increased knowledge and ability which time and experience have brought the competent lamp manufacturer is no longer troubled by questions of life, and can turn his attention to the more important feature of sustained candle power. The aim is now to produce a lamp which will maintain the best average rating in candle power and watts, and it is on this line that the improvements in lamps in recent years have chiefly been made. These improvements have brought a change from the old point of view which judged lamps by life and initial consumption of watts, and has caused the adaption of a rational and adequate system of determining value—the average candle power and efficiency as given by a lamp during a fixed period of life.

Were the efficiency of an incandescent lamp, like that of a motor or a dynamo, a constant quantity, practically unchanged by duration of service, the initial efficiency rating would for a given voltage and candle power of lamp be a proper measure of its value. Such, however, is not the case, since as a result of the loss of candle power while in service a lamp's efficiency changes considerably, the watts per candle augmenting as a rule in direct proportion to the loss in candle power.

The average efficiency, therefore, differs markedly from the initial or starting efficiency. A proper measure of lamp value should consider not only the lamp performance at starting, but its after performance as well, for a given period of life. Average efficiency conforms to this requirement and becomes, therefore, the proper measure of lamp value and test of lamp quality. A reference to the right hand diagram of Fig. 1 will make these points clearer.

Here are illustrated the candle-power curves of four lamps, representing various American makes. These lamps are all between 115 and 120 volts, and were each and all tested at the exact initial efficiency of 3.1 watts per candle. They were all burned for 600 hours under constant voltage and the candle-power readings taken of each, at 75 to 100-hour intervals, were plotted and the curves shown in the diagram drawn therefrom.

Each of the lamps declines in candle power as the curves show; lamp No. 1 to 12 candle power at 600 hours; lamp No. 2 to 10½ candle power, and so on to lamp No. 4, which only gives 8 candle power at 600 hours.

If now the total watts taken by each of these lamps diminished in the same proportion as their candle power the efficiency in watts per candle would remain constant and the average efficiency would be identical with the initial efficiency of each.

The total watts consumed by a lamp during its life under uniform voltage remain practically constant, however. In Fig. 2 is shown

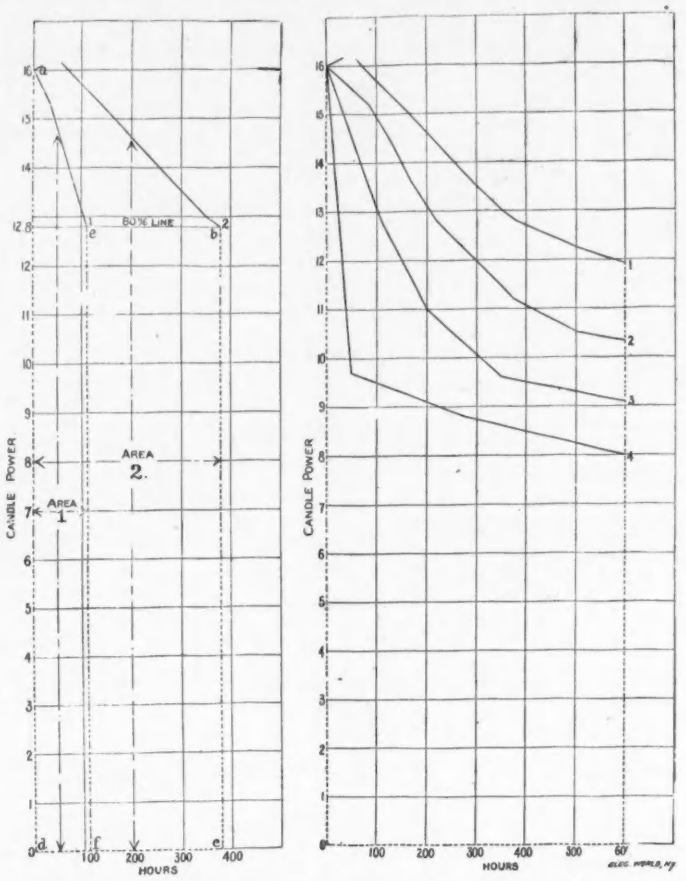


Fig. 1.—Curves Showing Decline in Candle Power of Incandescent Lamps during Life.

the curve of total watts consumption of lamp No. 1 taken out to 600 hours. From this it is seen that the watts consumed decline but slightly, averaging about 5 per cent.

As the candle power declines 25 per cent. in case of lamp No. 1 and 50 per cent. in case of lamp No. 4, the efficiency (or ratio of candle power and watts consumed) changes considerably. The following table gives the average and final efficiency of each lamp:

Lamp.	Initial.	Average.	Final.
No. 1	3.1	3.45	3.80
No. 2	3.1	3.70	4.35
No. 3	3.1	3.83	4.57
No. 4	3.1	4.28	5.46

That initial rating indicates practically nothing of the real quality of a lamp is here clearly shown—here are four lamps that as far as initial efficiency goes are equal and the same, and yet at the end of 600 hours burning lamp No. 1 shows a consumption of 1.66 less watts per candle than lamp No. 4.

The poorest grade of lamp, judged by initial rating, appears as good as the best. The incompetent manufacturer can on this basis claim equal standing with the most experienced. The simple device of making a lamp to consume a fixed wattage outweighs the paramount qualities of sustained candle power and uniform light. Thus have the true qualities of a lamp been obscured, its chief function

as a light producer ignored, and the purchaser and lighting public misled.*

A station manager might as well determine the volume and value of his business by the peak of his load, as to attempt to fix lamp quality by initial efficiency. The insufficiency of the initial rating is still more emphatically shown in the fact that of two lamps of different initial efficiencies the lamp consuming the greater watts per candle at starting will frequently consume less watts on the average. A good 3.5-watt lamp will show inside of 200 hours a better average efficiency than a poor 3-watt lamp. This is shown in the diagram given in Fig. 3.

The initial efficiency of a lamp can never form a correct basis of judging its quality or value. It is time that lamp users should understand the term and be made to know that it is at most simply a specification for the lamp similarly to its candle power and voltage.

In ordering lamps, the customer specifies the initial efficiency desired, as he does the voltage and candle power. He may obtain a 3.1-watt lamp or a 4-watt lamp, just as he wishes. There is no virtue in the mere isolated fact of one lamp taking 3 watts to the candle while another takes 4 watts—no more virtue than that one lamp should give 32 candle power as against another's 16 candle power. By changing the candle power through increase or decrease of voltage the initial efficiency can be changed within limits to any desired figure.

The following table shows the change in candle power and initial efficiency that can be produced through change in voltage:

VARIATION IN CANDLE POWER AND EFFICIENCY OF STANDARD 3.1 WATTS PER CANDLE LAMPS DUE TO VARIATION FROM NORMAL VOLTAGE.

Percentage of normal voltage of 3.1 watt lamps.	Percentage of normal candle power.	Efficiency, or watts per candle.
90	53	4.68
91	57	4.46
92	61	4.26
93	65	4.1
94	69½	3.92
95	74	3.76
96	79	3.6
97	84	3.45
98	89	3.34
99	94½	3.22
100	100	3.1
101	106	2.99
102	112	2.9
103	118	2.8
104	124½	2.7
105	131½	2.62
106	138½	2.54

This lowering and raising of pressure causes the temperature of the lamp filament to change, emitting a lower or higher candle powre, and as the power consumed changes in much less degree than the candle power the ratio of the two, i. e., the watts per candle or efficiency, is made to change.

From the foregoing it is evident that initial efficiency really is only a classification for lamps and not a measure of their value, and that its use for the latter is incorrect and misleading. The real measure of lamp value is the average efficiency, which includes not only the starting conditions but the conditions of performance in a given period of life as well.

The correct determination of both initial and average efficiency is directly dependent upon the candle power. If the candle power be overrated the efficiency will be also. Photometer measurements of candle power are on this account even more necessary than wattmeter measurement of power consumed.

The candle power of a lamp is, however, the one quantity which the average purchaser is not equipped for determining. The possibility of deceiving him in this particular is the incompetent manufacturer's opportunity. With candle power deception unchecked, neither initial nor average efficiency is determinate and the value of the lamp is unknown and uncertain.

How important, therefore, is it for central stations to supplement their instrument equipment with a good photometer, in order that they may not only know the value of lamps, and thus be able to select the best, but that they may also by their own testing hold the competent manufacturer to his best.

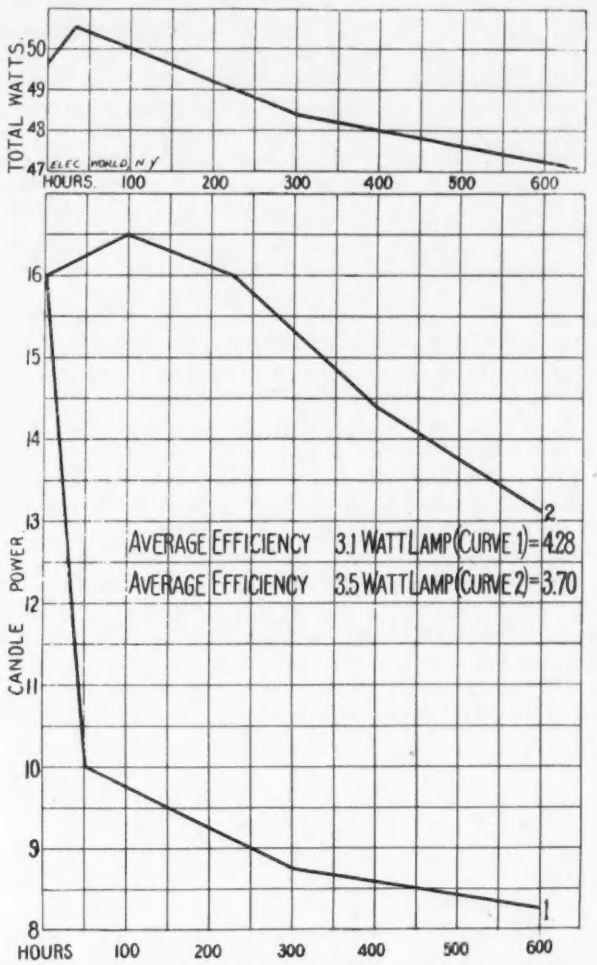


FIG. 2.—CURVE SHOWING CHANGE IN TOTAL WATTS CONSUMED BY AN INCANDESCENT LAMP DURING LIFE.

FIG. 3.—CANDLE-POWER CURVES OF A POOR 3.1-WATT LAMP (NO. 1) AND A GOOD 3.5-WATT LAMP (NO. 2), SHOWING THE HIGHER AVERAGE EFFICIENCY OF THE LATTER.

There is no article of supply purchased by lighting stations in which the need of securing the highest quality is more imperative than in incandescent lamps. Quality in incandescent lamps is absolutely essential and paramount to all other considerations, since the lamp determines the value of the commodity for sale—that is the light.

While there is need of some capable and impartial bureau of lamp testing to act as inspector of lamp purchases for lamp users, such a bureau is difficult to establish and would be but feebly patronized (even if established) with the present apathy exhibited by central station managers on this subject. What most is needed is aroused interest in and attention to this all-important subject of lamp quality. Nothing in the whole business of electric lighting is more in need of attention, and there is no branch of the business where care and attention will return more handsome dividends.

When photometers are generally used and correct determination of quality takes the place of mere initial watt readings, then, and only then, can we expect to see electric lighting companies rendering unto themselves the values that should be theirs, and unto their consumers the returns that are due them.

*The above clearly shows that the true efficiency of a lamp, i. e., its average efficiency, is directly dependent upon the maintenance of candle power.

In an article on "The Importance of Quality in Incandescent Lamps" (published in THE ELECTRICAL WORLD, December 11, 1897), the writer established that maintenance of candle power was the most important factor in determining the value of a lamp.

Criticism was made that this method of valuing a lamp's quality did not consider efficiency. From the foregoing account it will be seen that maintenance of candle power is the factor which determines the real or average efficiency, and that, therefore, efficiency is necessarily considered. The initial efficiency is made equal for all lamps under comparison. The lamp then that maintains its candle power best necessarily gives the best average efficiency.

With equal initial conditions, the maintenance of candle power in a given period of life correctly determines the quality of different makes of lamps. This measure includes and considers the three chief features of a lamp, its average candle power, its life (since a given period of life is taken) and its average efficiency, which is deduced from the average candle power.

Oscillatory Curves and Some of Their Phenomena—II.

BY PROF. E. F. NORTHRUP.

In the circuits shown above the condensers have been considered as consisting of two or more sheets of metal separated a short distance from each other by insulating material. Any such condenser, even when the separate sheets have a small area, will have a capacity large enough to make the oscillations much slower than is desirable for many forms of experiments which may be performed with oscillatory currents. When therefore it is desired to obtain the most rapid oscillations, such as are used for the production of electric waves (about which more will be said later), it will be found convenient to arrange the circuit as indicated in Fig. 6.

Here *S S* are two sheets or spheres of metal; *s* is the discharge gap and *l l* is the wire along which the very rapidly oscillatory currents flow. The two metal sheets, together with the surrounding air, form a condenser in all respects like the condenser in *E*, Fig. 1, except that it has a very much smaller capacity on account of the great distance that the plates are separated from each other and

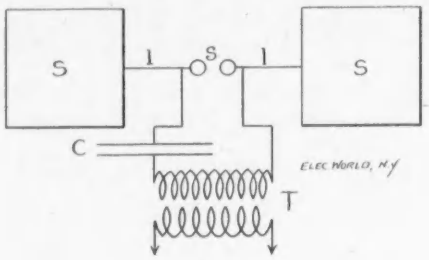


Fig. 6.

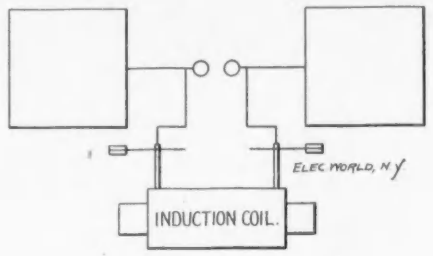


Fig. 7.

from other conducting matter. Another condenser, *C*, is indicated as placed in series with the secondary of the transformer *T*. The importance of this condenser rests on a practical point in the operation of the contrivance, as shown. The author has found that the secondary of a transformer generally gives such a large current that when the air gap *s* breaks down an arc of very low resistance is permanently established across this gap if the condenser *C* is left out, and that no true oscillations take place in the wire *l l*. By inserting a small condenser, as *C*, in the circuit of the secondary of the transformer the current becomes cut down to a low value, while the distance that the spark can jump in the spark gap *s* is not diminished. In this case the arc does not form permanently across *s* and

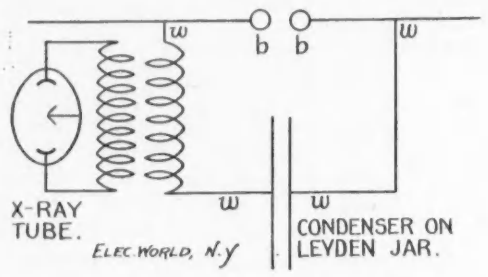


Fig. 8.

good oscillations are obtained. A blower or polished balls or other devices often used to break the arc will then often not be required.

The customary way of exciting oscillations in a circuit like the above is to employ in place of a transformer an induction coil, as shown in Fig. 7. This is the arrangement first used by Hertz in his experiments on electrical waves. An induction coil will not, however, give as good or as powerful effects as a transformer. The chief reason for this is that the induction coil only supplies energy to the circuit in which the oscillations take place, at comparatively long intervals, the discharge from an induction coil not being continuous, as it practically is from a high-potential transformer.

Oscillatory currents may be obtained also from a Holtz or influence machine. Arranging the circuits as in Fig. 8, where *b b* are the terminals of the influence machine, very rapid oscillatory currents of small energy may be obtained in the circuit *W W W W*, but of sufficient power in the case of a large machine to excite vacuum tubes and X-rays. In the case shown the induced current will pass through the vacuum or X-ray tube when the spark passes between *b b*.

I shall now show some devices which ought to give oscillatory currents of great power, although I have never had an opportunity to actually test the matter. I offer the devices as of sufficient interest to be worth testing by experiment.

In Fig. 9 *D* is a direct-current dynamo of any voltage, *I* is a coil of a great many turns of heavy wire wound on an iron core, *c c*. *C* is a condenser, *s* a spark gap between balls about an eighth of an inch apart. *P* is a coil of a few turns of large wire and *f* a coil of fine wire. *K* is a device by means of which two carbons may be made to touch each other and then be drawn quickly apart until the arc which forms on separating them is broken. Now it is well known that when a direct current is passing through a coil wound on an iron core and of a great many turns, that on suddenly breaking the circuit the current which is flowing in the coil tends to keep on flowing in the same direction with such persistency that a spark of considerable length will occur at the point where the circuit is broken. Hence if the carbon points at *K* are brought into contact and a large current flows through *I*, on quickly separating them an arc of low resistance will first form between the points and, when the separation becomes great enough, will quite suddenly break. The current in *I* will, however, tend to keep on flowing and as it has no other path to take will flow into the condenser *C*, charging this to a high potential, and, if matters are rightly arranged, this potential may be made great enough to cause a discharge to take place across the air gap *s*. If this occurs the condenser wil discharge through the coil *P* with an oscillatory current which will induce a current in the coil *f*. Thus a long discharge between the terminals *a a* may be obtained. It would be desirable to have the break in the circuit which is supposed to occur at *K* made at a number of different points at once. Devices for accomplishing this anyone can readly design.

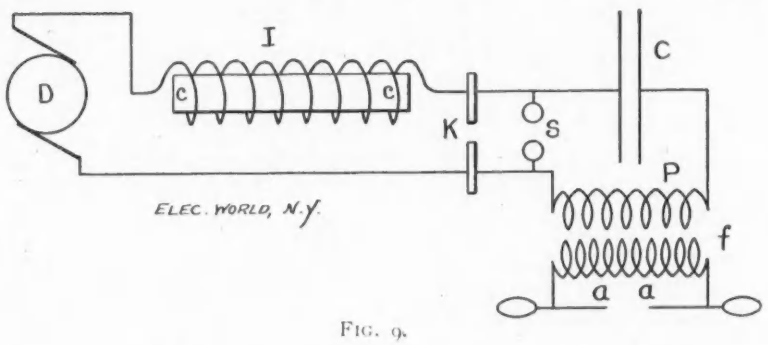


Fig. 9.

In Fig. 10 *A* is an alternating current dynamo, *T* a commercial transformer which will give across the terminals of its secondary a potential of 100 volts. *L* is a very large coil of wire wound on an iron core, or what would serve the purpose as well, the secondaries of several transformers connected in series. *C* is a condenser of moderate capacity, *P* a coil of a few turns of heavy wire, *f* a coil of fine wire and *s* a spark gap. Suppose that a momentary current flows through the primary of the transformer *T*, then a momentary E. M. F. will act in the secondary of the transformer, tending to start a current flowing through the circuit, including *L*, *C* and *P*. The condenser *C* will be charged to a low potential and will then immediately discharge, causing a weak oscillatory current to circulate in the condenser circuit. Assume now that each time this oscillatory current starts to flow in one direction or the other a new current is sent through the primary of the transformer in such a direction that the E. M. F. induced in the secondary of the transformer helps the current which is already flowing in the secondary along in the same direction. This current will then evidently be increased. If we start a rocking chair rocking and each time it starts to go back in one direction give it a slight push it will be made

by very slight impulses to rock back and forth a great way. If the impulses given to the chair are not rightly timed it will almost be brought to rest. Just so in the above electric circuit. If the oscillatory current has a natural rate of swing back and forth in the circuit and the alternating current through the primary of the transformer changes its direction at the same rate as the oscillatory current naturally swings, the surgings of this latter current will become very great and the condenser *C* will become charged to a very high potential and with a large quantity of electricity. The potential to which the condenser may be charged, by rightly varying the natural period of its circuit until it is the same as the period of the alternating current through the primary of the transformer, may be made fifty times as great as the potential which could be obtained from the secondary of the transformer alone. Or, in other words, the potential

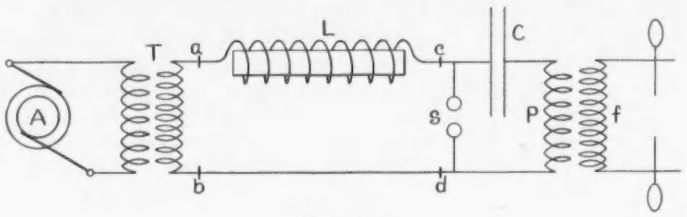


FIG. 10.

between the points *c* and *d* may be made fifty times as great as the potential between the points *a* and *b*. If the potential between *a* and *b* is 100 volts the potential between *c* and *d* would be great enough to cause a discharge to take place across the air gap *s*, and this would cause a much more rapid series of oscillations to take place through the coil *P*. These could be used to induce a very high potential in the coil *f*. The circuit may be adjusted to resonance, as it is called, with the alternating E. M. F. in the transformer, by varying the number of turns in the coil *L* or the amount of iron in this coil, the capacity of the condenser, or, where it can be managed, by varying the speed of the alternator *A*.

The Welsbach Electric Lamp.

A good account of the new filament for electric lamps developed by Dr. C. Auer von Welsbach is given in the London "Electrical Engineer," abstracted from the "Journal für Gasbeleuchtung." What might be called the core of the new filament is made of osmium, a metal similar to platinum, but with a much higher fusing point, the highest of any known metal. In vacuo an osmium filament may be heated to the temperature of the volatilization of platinum and still show no signs of melting. As the intensity of the light radiated increases more rapidly than the fifth power of the absolute temperature, the filament at this heat gives out a white light of great intensity. Dr. Welsbach has also experimented with other metals raised to temperatures above their fusing point, but closely enveloped in a thin coating of a highly refractory material, such as thorium oxide, which prevents the inner melted metallic filament from breaking. The thorium also serves as a radiating substance and not—as in the Welsbach gas mantle—as a skeleton on which cerium oxide with its peculiar radiating power is mounted, this latter material not being utilized at all in the Welsbach electric lamp.

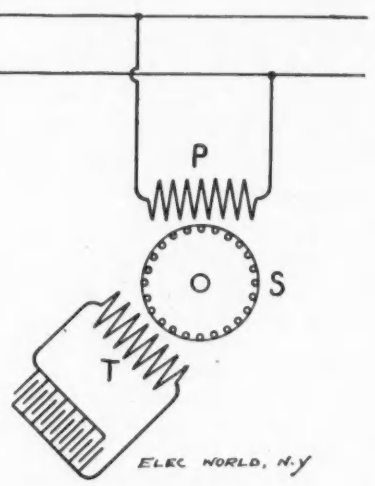
The Couplings of the Generator at the New York Athletic Club Building.

The description of the four generators coupled to one shaft, with an engine direct-coupled to each end of the shaft, in the article on "The Electrical Equipment of the New York Athletic Club House," in THE ELECTRICAL WORLD of April 16, was in error as to the coupling arrangements used. The dynamo armatures—instead of being mounted on sleeves which may or may not revolve with the shaft running through them, being connected thereto by clutch couplings—are mounted directly on this shaft. The shaft is divided into two parts which are coupled together in the centre of the group and to each engine at the outboard ends. The arrangement, as erroneously described, is covered by the patent claims granted to Mr. B. J. Arnold, the actual arrangement being quite different and free from fundamental patent claims.

To Improve the Power Factor of the Induction Motor.

Two patents, Nos. 602,920 and 602,921, were granted to Mr. C. P. Steinmetz April 26, 1898, on a proposed improvement in the design of induction motors. The purpose of this invention is to eliminate the lagging or magnetizing currents, this being commonly done, if done at all, by the action of condensers or apparatus giving a condenser action across the same lines which supply the induction motor. This, however, does not compensate for lagging currents within the motor itself, and thus, therefore, does not increase the efficiency, the power factor or the output of that part of the system. The modification also enables induction motors on single-phase circuits to be started with considerable torque. It consists fundamentally of an auxiliary circuit, called the tertiary circuit, wound on the same part of the motor on which is wound the primary circuit, whether this be the stator or the rotor, this tertiary circuit being connected either directly or with the aid of a step-up transformer with a condenser or any other apparatus which will take leading currents.

As shown diagrammatically in the accompanying illustration, the primary circuit, *P*, is connected across a source of single-phase alternating currents; the secondary circuit, *S*, is short-circuited on the rotor and the tertiary circuit, *T*, is wound on the stator at an angle with the primary such that part of the flux induced by the primary will pass through it, and by virtue of the condenser action set up in it leading currents which, on account of the obliquity of the primary and tertiary windings, will give a rotary field action tending to exert a starting torque in the secondary. The device for this purpose alone is not new, although broadly claimed in the patent, but the further value of the tertiary circuit and condenser to balance out the lagging or magnetizing currents of the rest of the system does not seem to have been hitherto appreciated. By arranging the tertiary circuit in quarter phase relation with the primary circuit the magnetic flux set up by the latter does not affect the tertiary at all when the rotor is at standstill, and therefore there is no starting torque set up, but on starting the rotor the currents induced in the secondary by the action of the primary set up an alternating flux in the tertiary synchronous with that in the primary, and the condenser reacts upon these, giving leading currents which again react upon the secondary and the primary.



The device is also broadly claimed for an ordinary induction motor, regardless of the number of phases of the source of supply, although only shown in diagram in connection with single-phase lines. When used on multiphase motors it would appear that the tertiary would have to be wound in the same slots as the primary winding, and the condenser action could better be obtained directly by shunting the condensers on the primary coils than by connecting them inductively thereto, by means of coils wound on the same iron. In case the condenser was shunted on the primary windings the lagging currents would be left in the motor, the condensers obviously being simply shunted across the main lines. If a tertiary winding were provided for the condensers, the lagging currents would be taken out of the motor windings, but an extra winding would be provided to carry the magnetizing currents, which would increase the copper losses more than the other factor would diminish them. The only compensating advantage apparent is the possibility of making the tertiary circuit of higher voltage than the primary and thereby reducing the capacity needed.

Sectional Conductor Electric Railways—III.

BY GEORGE T. HANCHETT.

Another device, shown in Fig. 38, substitutes a flexible woven ribbon for the chain. This ribbon consists of both copper and iron wires. The iron wire is necessary in order that the ribbon may be lifted and make contact with the plates upon it, and the copper wire for its superior conductivity. Cases are on record where conduits partly filled with iron filings were used. The filings rise and make contact with the sectional conductors above them. A great trouble with such devices as this is the uncertainty of the contact afforded by the flexible member with the conductors upon it, and its great liability to become misplaced or bunched, thereby making permanent contact with the section.

A large class of magnetic closers includes those which depend upon magnetic influences rather than gravity to open the circuit after the car has passed. The device usually involves a magnet on either end of the car. The primary objection to these is that the magnetic opening of the circuit is not nearly so reliable as a gravity method, and though such devices may be easily operative there is a certain element of uncertainty about them. A few examples will suffice. One of them is shown in Fig. 39. A magnet on the car attracts the armature *20*, operating the ratchet and making contact this armature, which therefore remains in contact as long as the car is drawing current from that section, but when the car leaves the section and current ceases therein the armature will fall under the influence of gravity and disconnect the rail. In order that the car may be able to run in both directions on the same track a second magnet must be provided at its other end, to be appropriately connected in circuit when reversal is made. This magnet may be turned to good account by exciting it to the same polarity as that of the attracted armature within the automatic device. Its influence will then assist the armature to disengage itself from the stud to which it has been feeding current, by destroying the remanent magnetism which might cause it to adhere. The details of another arrangement on this plan are shown in Fig. 43. In this a magnet operates upon the plate e_2, and lifts an electromagnet into contact therewith, in which position it will remain as long as current is drawn from the plate. It falls when current ceases in its coils, and its fall may be insured by the magnet on the rear of the car, which will repel the movable magnet if its connections are suitably changed.

These devices have numerous advantages. There are no arcs in the automatic circuit closers, for their construction is such that they cannot break circuit until all current in them is ceased. Gravity is the restoring force, and careful design should make the automatic device cheap and reliable. Furthermore, the initial impulse must be

FIG. 38.

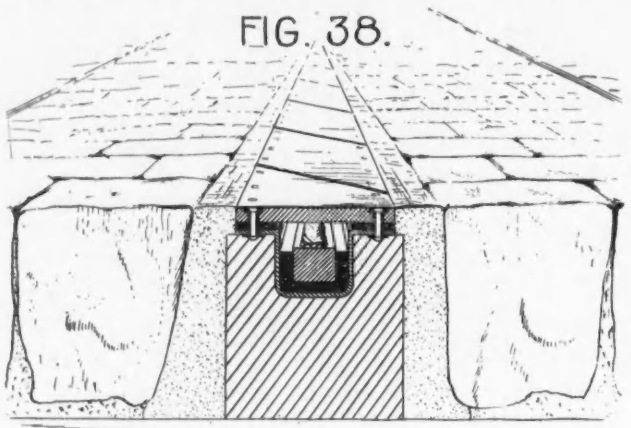


FIG. 39

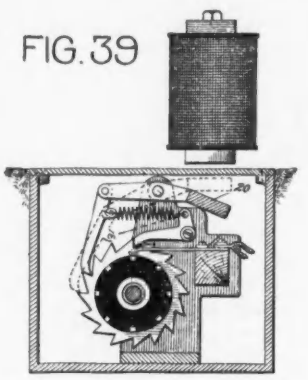


FIG. 40.

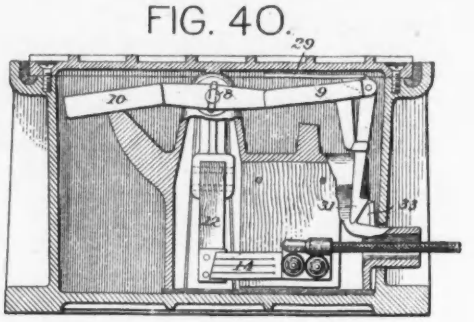


FIG. 41.

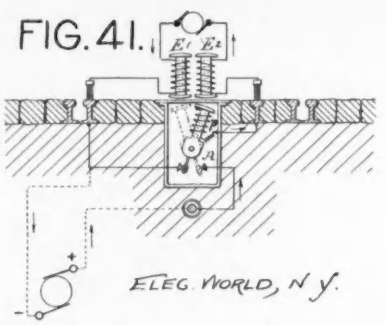
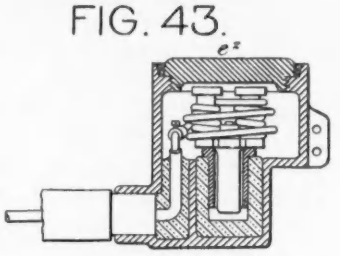


FIG. 42

FIG. 43.



by means of a commutator and clip. A magnet on the rear of the car again attracts the armature just as the car is leaving the section and moves the ratchet another tooth, thereby breaking circuit.

Another device by the same inventor is shown in Fig. 40. Two armatures *9* and *10* are provided on a tilting frame, which moves the pivot *8* and thereby the arm *12*, opening and closing the knife switch *14*. The magnet on the front of the car first attracts the thin plate *29* unlatches the hook *31* from the lug *33*. The magnet is then free to tilt the frame and close the circuit. A second magnet on the rear of the car attracts the armature *10* and opens circuit, and the latch securely locks the device in this position. This is one of the best devices of its class, but the valuable feature of a gravity opener has been sacrificed.

The device shown in Fig. 41 is similar in principle, but different in detail. A magnet E_1 on the front of the car attracts an electro magnet f, tilting it and making contact at A, thereby supplying the adjacent sectional rail with current. A magnet on the rear of the car E_2 tilts the magnet f back into its former position. The electromagnet f is energized when it makes contact with A, and its polarity is such that it will be strongly attracted by the magnet E_2, thus making the breaking of circuit more certain.

Another class of magnetic closers covers those which use electromagnetic means to hold the contact closed while the car is passing, the primary influence being that of a magnet carried on the car. Fig. 42 illustrates a device of this class. A magnet attracts an armature to a stud, thereby making circuit with and energizing a sectional rail. All current fed to this rail passes through a coil about magnetically imparted to the circuit closers. Leakage currents of any kind cannot operate them, although when once in circuit they might enter them and maintain contact unless suitable devices were provided to prevent them.

A very interesting class of magnetic contact devices comprises what are known as traveling closers. One of the simplest of these is shown in Fig. 44. A closed conduit is provided, of which a section is shown. A live conductor is placed in the right hand side of the conduit, and a sectional dead conductor in the left. The latter conductor is connected to corresponding sections, which are exposed to the contact of a brush carried by the car. Within the conduit is placed a hollow steel ball K, which is powerfully attracted by a magnet carried by the car but not shown. It is lifted into the position depicted and thereby makes contact between the live conductor and the adjacent sectional rail. As the car proceeds the ball rolls along with it, always keeping under the magnet, thereby cutting in and cutting out the appropriate sections. If the influence of the magnet be removed the ball drops, and thus if the traveling closer escapes the car, either rolling ahead or being left behind, there is no live section in the roadway. Unfortunately the device provides no sure means for keeping the ball always under the car in case the magnetism of the controlling magnet should be lost for any reason.

Another traveling closer is shown in Fig. 45. In this closer the traveler itself is an electromagnet, and the current fed to the car passes through it. The magnetic attraction between the inner and outer magnets is thereby strengthened, and the chance of losing the traveler is less, and moreover the contact that it makes is more sub-

stantial. Devices have been provided whereby the magnet carried by the car attracts pivotal armatures on the traveler. These armatures operate pawls which would, if the magnetic influence was removed, engage in notches in the conduit, bringing the traveler to a full stop. This would have the effect of stopping the traveler in case the magnet failed, but would not prevent the car from coasting away from it. A motor-driven traveler has been patented in which means have been provided for always keeping it under the car, but this falls more properly under another class, and will be described under electric closers.

One or two special forms of magnetic closers deserve attention. In Fig. 46 is depicted one in which a large magnet energizes the rails, which in turn influence through suitable magnetic conductors a polarized armature which can oscillate on bearings. Two magnets as described are carried by the car, one in front and one in the rear. The first magnet sends the flux through the armature in such a way as to twist it and make contact as shown in the figure. The second magnet reverses the polarity and restores the armature to its normal position.

Another device which is ingenious chiefly for its complication is shown in Fig. 47. It consists of a magnet hung from one end of the car, which engages with and lifts a peculiarly shaped casing which is suitably pivoted. Before the case can fall it is caught and retained in its elevated position by a contact shoe, as shown at the right of the figure. Within the case are metal balls which, when it is tilted into its operative position, roll between two metal plates and make contact therewith. Gravity restores the automatic device to its normal position.

A very unique system is shown in Fig. 48. It can hardly be called a magnetic closer, nor is it correctly defined as an electro-magnetic one. The car carries a heavy iron skate, which can also perform the office of collecting if necessary or desired. This iron skate simply completes a magnetic circuit and thereby enables the magnet contained within the contact box to lift an armature and make appropriate connections. The magnets in the contact box may be continuously energized by a separate circuit, or the action of the armature may be such as to cut in circuit with a source to supply its electromagnet and that of the box ahead. The operation would be apparent. The electromagnet upon which the skate was about to impinge would first be energized and the completion of its magnetic circuit would cause it to attract its armature. When the armature was thus attracted it would close its own circuit and maintain its magnetism even though the armature on the box behind fell, and it would thereby prepare the box ahead for the action of the iron skate. It is obvious that with this arrangement at least one box would have to be in closed circuit before the next one could be operated, and thus an ordinary magnetic connection of two exposed ends would not cause the magnet to attract its armature.

A great disadvantage of all magnetic, and it may be added electromagnetic systems as well, is that means must be provided entirely independent of the power house for exciting the operating magnets. Normally these magnets are excited from the motor circuit, but if for any reason their power should be lost, the car would be helpless until a storage battery or auxiliary device was brought into play to get the system started once more. For this reason the last method described here is deserving of some attention. It is hard to conceive of how a solid iron skate could get out of repair, and moreover it needs no auxiliary device carried by the car to magnetize it. It is not too much to say that some devices employing this principle might prove practical.

FIG. 44.

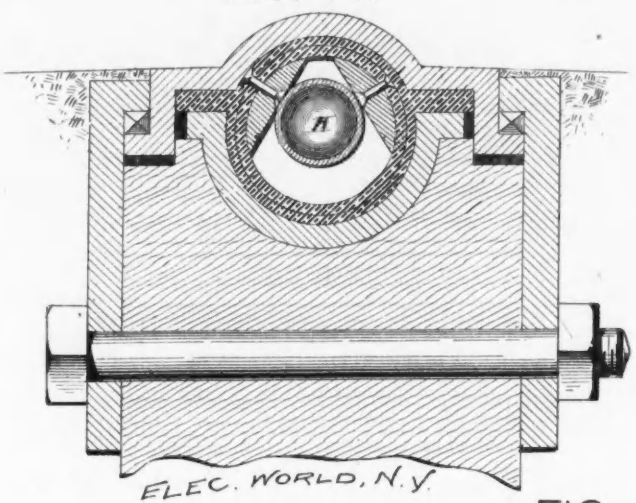


FIG. 45.

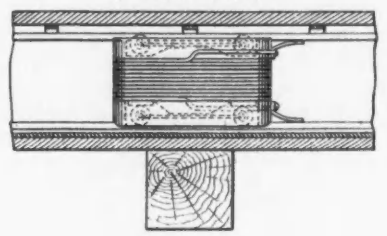
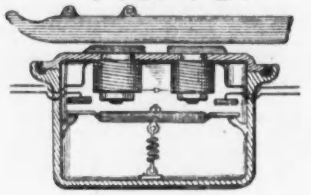


FIG. 48.



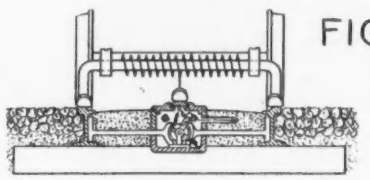


FIG. 46.

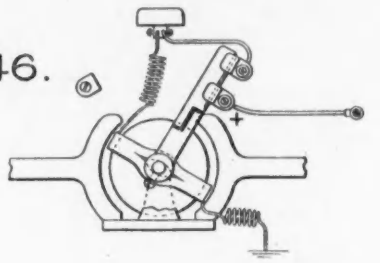
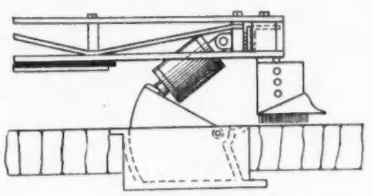
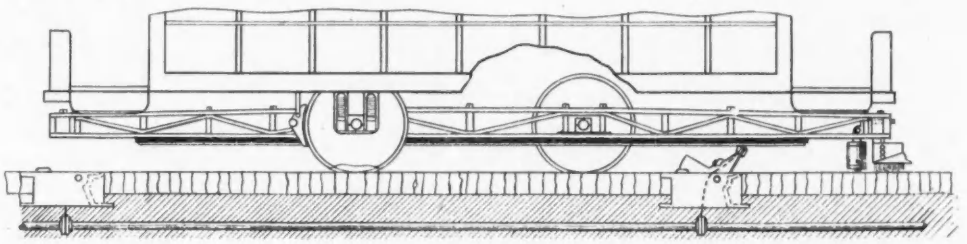


FIG. 47.





Electric Power Companies and Their Relation to Municipalities.

On the 26th of April Mr. A. E. Lang, president of the American Street Railway Association, was the guest of Purdue University, Lafayette, Ind. In the evening he delivered an address before an audience of engineering students. After being introduced by Professor Goldsborough he spoke in part as follows:

Consideration of the relation on the part of an electric power company to the station producing the current, on the one hand, and to the community consuming it on the other, opens a field of thought and discussion quite beyond the possible limits of a single paper.

There is a two-fold object which must be accomplished. First, the investment of capital must be made profitable to the investors, and second, the community must be served in the best possible manner at a minimum cost.

No new or improved electrical equipment of either street railway or light company makes its appearance that the community does not demand and the enterprising manager desire to supply. If the company does not respond the community then demands that it give way to some other company which will do so. Failing in this the cry goes up for municipal ownership. The community gives little thought to the financial condition of electric or even other quasi-public corporations, but is ever demanding more—more. This is American, and we are put on our mettle to meet these conditions How shall they be met?

It must be borne in mind that many existing power companies, meaning, of course, street railway and electric light companies, have passed through very costly experiments growing out of crude

machinery and apparatus they were forced to buy and inexperienced and incompetent persons employed to install and put the same into operation.

Finding that expenses were exceeding revenues, and grasping at every promising improvement offering greater economy, change after change has been made and is still making, to reach better results, all of which has required increasing capital stock and the issuing of bonds.

There was no other way to avert failure and avoid the sheriff, and thus many companies have gone forward piling up debt upon which interest must be paid, and still the end is not yet. Every new plant installed possesses some new features that offer better service with greater economy, and this forces existing plants to again remodel and change and create more debt, and consequent increased interest changes.

A condition such as this is of course unfortunate, both for the community and for the company; and no doubt leads to much discussion of the question of municipal ownership of these properties. Vainly believing that the cost of such service can be materially reduced and profits proportionately increased, municipalities desire to reap the supposed harvest. This I believe to be erroneous under present forms of society and government.

I do not believe that municipal ownership of such properties is wise in any sense nor that much will be done in this direction, especially if private corporations keep pace with the best methods of service and offer reasonable rates.

I am one who believes that the community will deal with these corporations fairly, if the corporations will be equally fair with the community. Some corporations are too exacting—too much inclined to reap a harvest of quick return by way of dividends, and provide a rapidly accumulating sinking fund to wipe out original investment.

This method, though Yankee-like, and generally called business-like, is not the prudent or wise way of handling corporations dependent on the public for their existence. A better way, it seems to me, is to take the public into your confidence, deal fairly and even generously with it, give the best possible service at the smallest profit consistent with a fair return on the investment and reasonable provision for meeting outstanding obligations and future depreciation, in which event the community will deal fairly with you.

Citizens should be made acquainted with all the conditions governing properties of this kind, should be informed of the reason for incurring the debts which generally exist, and of the annual and contingent burden we assume. Fulfilling these conditions, fair prices will usually be allowed for transporting passengers upon our railways and power and light supplied.

Where the company is left free to fix its own prices no advantage should be taken, but a reasonable and just charge should be made as above indicated. The tendency of the present age is toward lower prices for labor as well as for the product of farm and factory, and lower interest on money; and electric power companies must meet it.

To do this no better method can be found than by consolidating under one roof all electric power companies where conditions are favorable. Re-equip with the latest and best types of machinery for generating current, rearrange circuits for better power distribution, introduce better lamps, repair and keep in good order all the apparatus appertaining to the street railway and light plant. Give the best of service.

There is frequently no other way this can be done but through consolidation, and this can be accomplished without criticism or objection on the part of the community if followed by reduced cost to the consumer, with first-class service rendered.

Corporations, like individuals, sometimes make mistakes, and through miscalculations of the expense of construction and operation, or in the eagerness to secure grants, they assume contracts upon terms too low to permit giving the best of service, with the result that great dissatisfaction is expressed by patrons and citizens generally, and the warfare between the city and company begins. Furthermore, when such corporations have reasonably profitable contracts they are sometimes mismanaged by their avaricious owners, scanty service is rendered their patrons, and the result is the same.

Again, municipalities in some instances, through the prejudice of political aspiration of their governing boards seeking advantage by every method known to their officials, harass corporations, and thus force them to retaliate by giving poor service.

A Short Method of Determining Transformer Efficiency.

BY S. E. JOHANNESEN.

The method in general use for determining transformer efficiency is extremely laborious, and liable (on account of long multiplications and divisions) to error.

The general formula used, and from which a shorter one may be deduced, is:

$$\frac{\frac{n}{100}W}{W_i+\left[\frac{n}{100}C_p\right]^2R_p+\left[\frac{n}{100}C_s\right]^2R_s+\frac{n}{100}W}\,100$$

where $\frac{n}{100}$ is the fractional part of the rated load at which the efficiency is desired, W is the rated capacity in watts of transformer, C_p is the primary current in amperes at full load, C_s is the secondary current in amperes at full load, R_p is the primary resistance, R_s is the secondary resistance, and W_i is the iron loss in watts.

Factoring the above formula gives:

$$\frac{\frac{n}{100}W}{W_i+\left[\frac{n}{100}\right]^2(C_p{}^2R_p+C_s{}^2R_s)+\frac{n}{100}W}\,100$$

Now $(C_p{}^2R_p+C_s{}^2R_s)$ is the copper loss in watts of the transformer at full load; representing it by W_e the formula becomes:

$$\frac{\frac{n}{100}W}{W_i+\left[\frac{n}{100}\right]^2W_e+\frac{n}{100}W}\,100$$

The formula is now in terms of watts. Dividing both numerator and denominator by 1 per cent. of the rated watt capacity, $\frac{W}{100}$, we have:

$$\frac{n}{\frac{100W_i}{W}+\left[\frac{n}{100}\right]^2\frac{100W_e}{W}+n}\,100$$

The terms $\frac{100W_i}{W}$ and $\frac{100W_e}{W}$ are the per cents. of iron loss and copper loss, respectively, at the rated capacity of the transformer, and remain constant through all loads; n is the per cent. of load at which efficiency is desired.

In order to illustrate more clearly the advantage of the short over the general method we will determine the efficiency of a given transformer by comparison.

Problem:

Determine the efficiency at three-quarter load of the following transformer:

Rated capacity, 6250 watts.
Voltage of primary, 1000.
Voltage of secondary, 100.
Resistance of primary, 1.6 ohms.
Resistance of secondary, .016 ohms.
Iron loss, 107 watts.
Primary current at normal voltage, 6.25 amperes.
Secondary current, 6.25 amperes.

The per cent. of iron loss at rated capacity is 1.712. The copper loss calculated from resistance is 125 watts, or 2 per cent.

EFFICIENCY BY GENERAL METHOD.

At three-quarter load:

$$\frac{\frac{75}{100}\times 6250}{107+\left[\frac{75}{100}\times 6.25\right]^2 1.6+\left[\frac{75}{100}\times 62.5\right]^2.016+\frac{75}{100}\times 6250}\,100=96.35\%.$$

EFFICIENCY BY SHORT METHOD.

At three-quarter load:

$$\frac{75}{1.712+\left(\frac{75}{100}\right)^2\times 2+75}\,100=96.35\%.$$

This method might well be called the 'Per Cent. Method," for all the terms of the formula are in per cent.

The same principle can be applied in determining the efficiency of other apparatus.

At the Exhibition.

THE NATIONAL PHONOGRAPH COMPANY, St. James Building, New York, shows a full line of phonographs and accessories. Phonographs of all sizes and forms are attractively displayed, and the brass horns, at first glance, suggest the presence of a brass band. This exhibit occupies a part of the space of the Edison Manufacturing Company.

THE AMERICAN PULLEY COMPANY, Philadelphia, Pa., has an exhibit of a line of pulleys of various diameters set on upright shafts. At the back of the booth, against the wall, are arranged pulleys of different diameters in pyramid form. The exhibit is under the charge of the Niles Tool Works, which is the distributing agent of the American Pulley Company.

THE NILE TOOL WORKS, Hamilton, Ohio, make an excellent display of some heavy machine tools. These machines attract a great deal of attention from mechanics and others through their excellence of finish. A large planer occupies a prominent position in the booth. There are also a large drill, power and foot lathes, Brainard milling machines, etc. The Niles Tool Works necessarily occupies a large space on account of the character of its exhibit.

THE GEORGE V. CRESSON COMPANY, Philadelphia, Pa., is well represented by various lines of power transmitting machinery. Two lengths of shaft connected by a universal coupling are set on pedestal journals. On the shafts are a rope pulley, belt pulley, loose pulleys, screw gears, a perforated pulley and a clutch. Other shafts placed at right angles are fitted with bevel gears and worm gears to show the different methods of power transmission. The location of the exhibit is on the main floor.

THE EDISON, JR., LAMP comes in for a large share of attention at the exhibition. Mr. T. A. Edison, Jr.'s, exhibit occupies the first booth on the right on entering through the main entrance. At the back of the booth is an upright board 9 feet square, in which are set concentric circles of Edison, Jr., lamps of various voltages and colors. There are three outer circles, then a space, and inside of that are smaller circles. In the space between the outer and inner circles the words "Edison, Jr., Lamps" are wrought in frosted lamps, and when these are lighted they attract a great deal of attention. The colors of the lamps are amber, blue and green. There are also shown white bulbs, frosted and plain. Several bung-hole lamps are also shown. The various lamp circuits are controlled by a panel board set on the wall. The exhibit board is wired on the three-wire system.

EXPLOSION OF MINES BY HERTZ WAVE TRANSMISSION.—On Friday, May 6, the explosion of the miniature mine in the central tank, which had been effected in the ordinary way previous to that date, was accomplished by Hertz wave transmission, the apparatus being supplied by the United States Electrical Supply Company, 141 East Twenty-fifth Street, New York. The arrangement was simple, the circuit of the mine fuse being closed by a relay controlled in turn by a coherer, which was affected by Hertz waves sent from an oscillatory discharge apparatus in the gallery. The details were carried out by Mr. W. J. Clarke.

ONE OF THE MOST INTERESTING FEATURES of the Electrical Exhibition is the booth of the International Correspondence Schools, of Scranton, Pa., whose New York enrollment office is located at No. 14 East Seventeenth Street. No better proof of the popularity of the methods of instruction employed by this institution could be shown than to watch some of their old students taking their friends away from the spectacular end to have them talked to by representatives of the schools. The large number of friends they have around them is accounted for by the fact that they have now over 45,000 graduates and students throughout the world. The booth of the Scranton schools is very attractive. A picture of the school buildings, 5 x 7 feet in size, surrounded by electric lights, showing the picture off to great advantage, hangs at the back of the booth. All engineers and electricians attending the exhibition who desire to obtain a technical education in engineering or electricity will find it to their interest to visit this booth.

THE GOLD STREET CAR HEATING COMPANY has a complete line of heaters, and exhibits their internal construction by a display of separate parts. This heater is fundamentally made up of a helically twisted rod enameled and carrying a helically coiled spring wire resistance winding on this helical core. This gives an enormous radiating surface in a small volume. Mounted

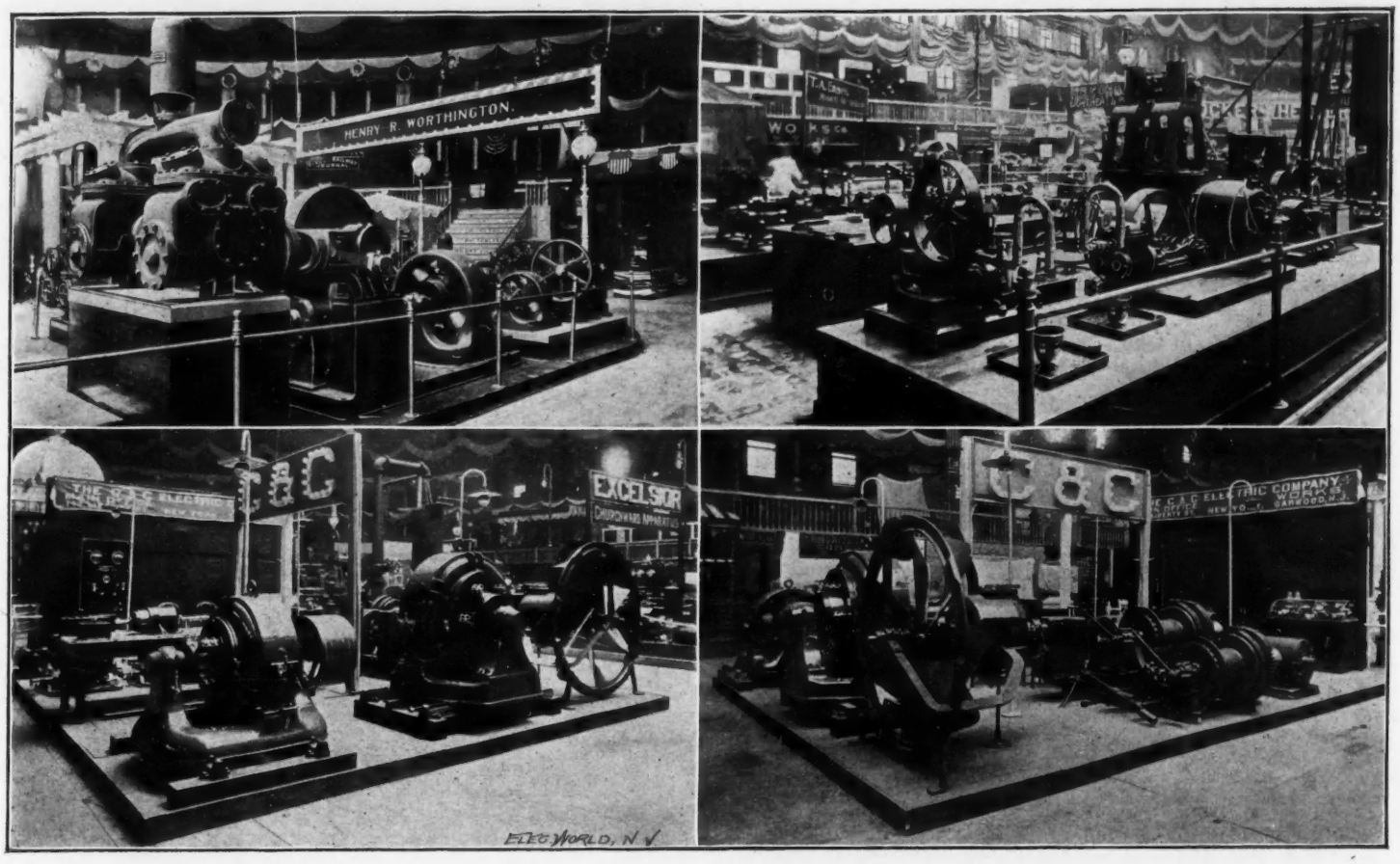


EXHIBIT OF H. R. WORTHINGTON.

EXHIBIT OF C & C ELECTRIC COMPANY.

in a perforated nickel-plated enclosing cylinder, it makes a suitable heater to put under the cross seats of cars. It is also shown in panels for cars and special panels for steamboat use and in cylinders for cooking purposes. A group of these coils is mounted in a neat iron case fitted with a register on top and supplied with forced draft from a small Sturtevant blower coupled to a Lundell 1-12-hp motor. This equipment is supplied with thirty amperes at 110 volts, and it is claimed that over 300 cubic feet of air per minute is delivered at a temperature of over 200 degrees Fahr. The exhibit is in charge of Mr. H. E. Beach, the Eastern representative of the company.

VACUUM TUBE LIGHTING.—One of the most interesting of the popular features of the exhibition is the vacuum tube chapel installed by Mr. D. McFarlan Moore. This miniature chapel is 27 feet in length by 10 feet in width, the architectural design being Gothic, the eight arches being outlined with long vacuum tubes about 2 inches in diameter, curved to fit into the arch, other tubes running the length of the chapel. This is the only light admitted. The power for this light is taken from the street mains of the Edison Company, high tension being obtained by inductive coils and the "rotator" break. This consists of a commutator shaped make and break device, with brushes bearing upon it, hermetically sealed in a vacuum tube. Mounted on the commutator shaft inside the tube there is also a segmental iron armature. This is revolved by a rotating field obtained from a Gramme ring mounted around the vacuum cylinder and supplied with current from a small rotary transformer. Other magnets, also outside of the vacuum, create a field of force across the commutator and brushes, thereby tending to still further reduce the sparking and increase the abruptness of the break.

THE NOWOTNY ELECTRIC COMPANY, Cincinnati, Ohio, occupies a neatly decorated enclosure in the first gallery on the right-hand side, and has a display of several of its new enclosed arc lamps, suspended from the top of the booth. The Nowotny lamp was described in considerable detail in a recent number of THE ELECTRICAL WORLD. It is remarkable for the simplicity of its construction, and is said to be a most satisfactory lamp in operation. One feature of the lamp is that it can be thoroughly examined without taking it apart. The resistance of the lamp is inside of the outer globe. This confines all the heat in the globe and removes the danger of burning out of the coil. The lamp is 28 inches long. Mr. Charles A. Aull is the Nowotny Company's electrical engineer and the designer of the lamp, and represents the company at the show. Mr. Aull says that he expects to soon place upon the market a 20-inch enclosed arc lamp which will be entirely different in construction to the lamp above referred to. It will be of very light weight. In the exhibit is an arc lamp burning singly across 220 volts and taking two and one-half amperes of current. The voltage across the arc is 160 volts. The arc is seven-eighths of an inch in length.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has an extensive exhibit at the east end of the main floor. The most prominent feature of this is one cell of the mammoth battery built for the Chicago Edison Company, this cell being mounted in a special case with glass windows to show the plates, of which there are eighty-three. One hundred and sixty-six of these cells will be put in service in Chicago, the capacity at a one hour discharge rate being 6000 amperes. Beside this great cell is another of twenty-seven plates of the same size, this being the largest ever built up to the time of the previous exhibition, two years ago. A large line of portable cells and small cells for various uses is also shown. Mounted on shelving at the back of the exhibit is a battery of sixty 11-F cells in glass cases and in service with a small differential booster to steady the lighting load taken from the generators in the basement, by supplying the fluctuations called for by the elevators in the neighboring exhibit—that of the Sprague Electric Company. One 11-F cell is rigged up to show spectators the process of melting eightpenny steel wire nails in two, and afterward welding the parts together again. This requires about 800 amperes. Phonograph and plating equipments are also shown. At the other end of the exhibit there is a 25-foot launch built by the Electric Launch Company, of Morris Heights, capable of running 6½ miles an hour, and with a mileage of 65 miles. (See illustrations.)

THE PARTRIDGE CARBON COMPANY, Sandusky, Ohio, the well-known manufacturer of motor, dynamo and generator brushes, whose goods are very extensively used and recognized as being among the best the market affords, makes a display of its products. Carbon brushes are not particularly handsome things to look at, but what they lack in appearance is made up in quantity in this case, for there are brushes a-plenty. This display is made in the booth of Wood, Shaw & Co., who are the New York agents for the Partridge Carbon Company. The brushes shown are of all sizes and shapes, for all the standard makes of dynamos, generators and motors. Mr. J. S. Partridge is in attendance and never wearies of brush talk. The thing that is largely occupying his attention just now, however, is the new electric light carbon for enclosed arc lamps. There has been a great demand for an American carbon that would work satisfactorily in these lamps, but heretofore, it is said, this call has not been satisfactorily met. The American carbons, it is stated, are objectionable on account of the excessive dust deposits they cause on the inner globe, which necessarily reduces the quantity of effective light. Mr. Partridge has been working for four years in an endeavor to solve the problem, and has at last produced a carbon that he claims to be in every respect equal to the imported carbons and far superior to American goods heretofore produced. Tests of these carbons have been made by the Nowotny Electric Company, and by others, and reports of the results are exceedingly gratifying. The carbons will soon be placed upon the market.

HENRY R. WORTHINGTON shows a complete line of Worthington steam pumps, electric pumps, condensers, meters, etc., of his latest design. The largest of these is a big duplex double acting horizontal cylinder machine built for elevator or town supply work for heads up to 300 feet. This is driven through worm gear by a G. E. multipolar 220-volt, 50-hp motor, which, at 900 r. p. m., gives the pump sixty strokes per minute, the capacity at this speed being 700 to 800 gallons per minute. A pump designed for boiler supply for central station auxiliary use is geared to a 10-hp G. E. motor. The pump is a 6 x 6 triplex, single acting machine, with horizontal outside packed plungers. It will deliver against 250 pounds pressure. One triplex steeple power pump with differential plunger is also shown geared to a G. E. motor. Several small belt-driven pumps for service in high building are shown, some of them being in operation and equipped with automatic start and stop mechanism. The belts pass over pulleys ingeniously arranged to give a large arc of contact on the small driving pulley even with a very short distance between centres, the idler also being spring mounted to keep constant tension on the belt. A Brighton gas engine belted to a double acting duplex pump is also shown. This engine is fitted for automatic governing at a speed that is manually adjustable while running. Many power pumps, admiralty pattern air pumps, condensers, etc, are also shown, as is the new valve motion for direct acting steam pumps, all the parts of the motion being made of rolled steel or drop forgings. (See illustrations.)

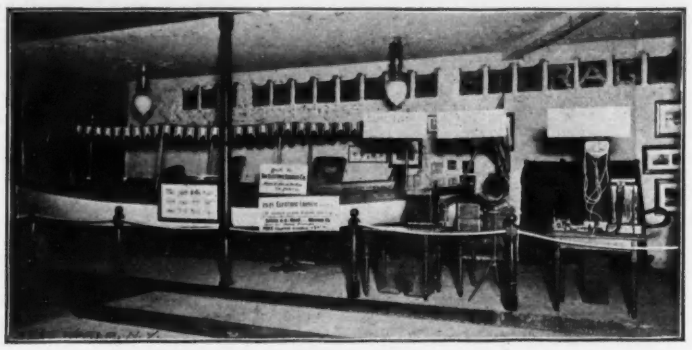
MESSRS. J. JONES & SON, 67 Cortlandt Street, New York, exercised considerable taste in the arrangement of their exhibit, which occupies the third booth on the right-hand side after passing in the main entrance. At the back of the booth is hung a display board, which is decidedly attractive. In the centre of the board is a large oval panel, and small panels of similar shape run along the top and bottom and both sides. To the top panels are fitted incandescent brackets of different styles and shapes; on the two-side panels are double-pole switches, and on the lower row are shown small switches, single and double and double throw. The large central panel is trimmed in light blue plush, and on this the name "J. Jones & Son" is set in 8-cp frosted globe incandescent lamps. When the name is lighted up it is very effective. At the right of the booth is a handsome switchboard made by the firm. The marbelized slate board is bounded by a heavy brass moulding. It is fully equipped with Jones switches, a Weston ammeter, a Weston voltmeter and a Cutter circuit breaker. At the back of the booth, in the space outside of the display board are shown panel boards, switches of all sizes, one of the new Ward Leonard circuit breakers, wall telephone sets and an automatic cut-off clock, used for the purpose of opening a circuit at any predetermined time. This latter device has been already fully described in the columns of THE ELECTRICAL WORLD. On the back counter is shown a line of porcelain shades of artistic design and handsomely painted. At the front of the booth is a long counter on which there is laid a profusion of articles, including electric sad irons, curling irons, soldering irons, an electric stove, desk and intercommunicating telephone sets, medical batteries, of which the company is making a specialty, fan motors, etc. Inside, Nature aids in rendering the booth additionally attractive, potted palms finishing off the beauty of the exhibit.

THE C & C ELECTRIC COMPANY.—One of the most interesting features of the C & C Company's exhibit is a 60-kw, six-pole, direct connected type generator. This machine, which gives 125 volts at 275 r. p. m., is made up with a cast-steel yoke and solid steel cores bolted to the yoke, one of the ingenious peculiarities of the machine being the location of the plane of cleavage or separation of the top and bottom halves of the yoke in line with the centre of a magnetic core, so that there is no magnetic flux across this plane of cleaverage. In this way the added reluctance of this joint is eliminated, as is also the risk of magnetic unbalancing introduced by it in other machines. The brush holding rig of this machine is most simple and substantial, consisting of two cast-iron rings or annular discs bolted together, with annular rings of fibre between them, and bearing brackets in which the brush holding pins are mounted. The cast-iron rings are used as conductors, the main leads being tapped off from lugs upon them. They are bolted rigidly to the machine, with no provision for rocking the brushes whatever, the field distortion being so slight that there is no necessity for moving the brushes after they are once set in place at the factory. A 40-kw, four-pole belt generator is also shown. In the line of motors a most interesting exhibit is an 18-hp double drum hoist, driven by a 250-volt iron-clad compound wound motor. Each drum is provided with a mechanical clutch coupling and mechanical brake and retaining ratchet. A 60-inch fan is shown direct coupled to a series motor of the two-pole concentric field and shaft style. This motor is equipped with a commutated field arranged for four speeds, from 150 to 300 r. p. m. The field commutating switch is fitted with magnetic release. There are also shown several iron-clad closed-type and open-type motors and one motor geared down for mill and shop work. A Case engine coupled to a 5-kw closed-type generator is shown, designed to give 110 volts at 650 revolutions. A considerable line of straight and curved field bipolar motors is also shown. An attractive switchboard is mounted at one end of the exhibit, equipped with Whitney instruments, C & C field regulators, Hill switches, I. T. E. circuit breakers and C & C starting boxes. Parts of motors, showing the formed coils, the commutator construction and the oil slingers on the commutator ends, are also shown on a table. (See illustrations.)

THE INTERNATIONAL ARC LAMP COMPANY, New York, makes a brilliant display in more than one sense. Its exhibit—MacIntire arc lamps—is scattered all over the Garden, spreading light everywhere, and the extreme brilliancy of the light emitted from the lamps and the handsome appearance of the lamps themselves excite universal and favorable remarks. At night the middle of the arena is bathed in a flood of light from the immense arcolier suspended from the Garden roof. This arcolier contains twenty-four MacIntire enclosed arc lamps arranged in three tiers, the top one containing twelve lamps, the second eight and the third and lowest four. At the lower end of the central supporting shaft is attached a fan motor with four slowly revolving blades. Below the fan the shaft is finished off with another MacIntire lamp. The light given out by the lamps on the arcolier is estimated at 40,000 candle power. The lamps are of various styles of finish, some with prismatic pendants around the shades and some with plain globes. The arcolier is an immense affair, made of tubing, and weights 1500 pounds. The lamps operate on four and a half to five amperes of current with eighty volts across the arc. In the handsome white temple-like structure occupied by the Edison Electric Illuminating Company, of New York, there are ten MacIntire lamps, eight special lamps being arranged along the cornice and two ornamental post lamps at the portals of the temple. Two ornamental post lamps face the Madison Avenue entrance in the Henry R. Worthington exhibit, and an ornamental prismatic pendent lamp hangs from the balcony at the Madison Avenue entrance. Two ornamental post lamps are displayed in the booth of the New York Electrical Society. Other lamps are displayed as follows: One polished brass pedestal lamp in the booth of THE ELECTRICAL WORLD, one pendent lamp in the booth of the National Carbon Company, of Cleveland, Ohio; one Silverine pendent lamp in the booth of the "Electrical Engineer"; two polished brass newel-post lamps at the speaker's rostrum; two service lamps in the exhibit of the

Nash Engine Company in the basement, and one pendent lamp in the booth of the "Western Electrician." Mr. George R. MacIntire is around the Garden much of the time, and is always ready and willing to enlighten inquirers on the subject of his lamp.

THE FOSTORIA INCANDESCENT LAMP COMPANY and the Crouse-Tremaine Carbon Company, of Fostoria, Ohio, together occupy a booth that is one of the most attractive in the entire building. At the front and on each side of the entrance are three white pillars—six in all—each surmounted by a globe set with vari-colored Fostoria incandescent lamps, the shafts themselves being entwined with spiral tendrils lighted with tiny decorative lamps of different colors. On a sample board at the back are shown Fostoria incandescent lamps of all voltages and styles of finish, including etched bulbs, corrugated bulbs, frosted bulbs, etc. The Fostoria "Duplex" lamp is also shown. This lamp has two standard 16-cp filaments so connected that by means of a simple switch on the lamp base one of the filaments can be cut out, thus giving a regular 16-cp light. With both filaments incandescent the lamp becomes



PART OF THE ELECTRIC STORAGE BATTERY COMPANY'S EXHIBIT.

32 candle power. Another important advantage of this lamp is that if one filament gives out the other filament can be used, thus giving a lamp of twice the life of the ordinary lamp. The 220-volt lamp is also shown. The Fostoria Lamp Company is said to be the second largest lamp manufacturer in the United States, and considering the fact that it has been manufacturing lamps for but ten months this distinction is an achievement of which it may well feel proud. The company is very ably represented by Mr. H. Sillson Hart, the Eastern representative, whose office is at 726 Broadway, New York. Mr. Hart also represents the Crouse-Tremaine Carbon Company, which has an exhibit of plain and coppered, solid and cored carbons. Seventy-two bundles of carbons are arranged in pyramidal form. A complete line of motor and generator

PART OF THE EXHIBIT OF THE ELECTRIC STORAGE BATTERY COMPANY.

brushes is also shown. The booth is very tastefully decorated, and at night is decidedly conspicuous. It is located in the gallery on the right-hand side.

THE H. B. CAMP COMPANY, Aultman, Ohio, has an exhibit that is particularly interesting to telephone, electric light and railway men. The company has a display of all sizes and shapes of its well-known vitrified clay conduits, which are very extensively used for telegraph, telephone, electric light, electric power wires and cables. The exhibit is on the main floor near the Fourth Avenue end of the building, and on counters are displayed samples of the different styles of ducts made by the Camp Company. One of the features of the display is an insulator for supporting electric cables, which is used on the elevated railroad in Chicago. The insulator is in the shape of a bridge, having five grooves in which to lay the cables. It is stated that these insulators have an extremely high resistance, and are giving excellent satisfaction on the Chicago lines. A special piece of vitrified clay work is a T-piece for underground distribution. Elbows for turning curves, joints, etc., are also displayed in large numbers. The principal feature of the Camp Company's exhibit is in connection with a nearby exhibit on the main floor. In the latter is shown a section of underground conduit construction, and on the rails a Broadway car is run to and fro to illustrate the operation. The H. B. Camp Company's exhibit in this connection shows the method of laying the vitrified ducts in railway work. Part of the duct work is entirely surrounded by a thick layer of cement; the other part shows nine ducts cemented together, without any outside layer of concrete. This latter section is said to be practically as strong as that imbedded in concrete, and is certainly much less expensive to install. The ducts are laid in such a way that their adjoining ends are staggered. This gives a much stronger construction, of course. A new form of duct is shown in the exhibit of the Camp Company. It is made in two halves, the division running lengthwise. This new form is intended to facilitate repair work, and all that is necessary is to remove the earth on top and then the upper section of the pipe in order to gain access to the cables. The Camp vitrified conduits are made of especially mixed clay, which, when fired, produces a remarkably tough material, its strength being almost equal to that of cast iron. The Metropolitan Street Railway Company, New York City, has laid over 2,400,000 feet of this conduit, and the New York & New Jersey Telephone Company bought large quantities of it during the past year. Mr. Henry H. Camp, of the New York office, and Mr. A. L. Daniels, are looking after the company's interests.

THE EDISON MAGNETIC ORE SEPARATOR is one of the most popular exhibits at the show, and attracts a great deal of attention, as does everything with Mr. Edison's name attached to it. A small operating model of the separator shows the practical operation of separating magnetic ore from the sand, as carried on at Mr. Edison's works at Edison, N. J. As the finely crushed rock falls in front of the faces of the electromagnets the magnetic ore is deflected by the magnetic attraction and falls into a special receptacle, while the sand, etc., falls straight down into another box. In the booth, which occupies a prominent position along the central aisle, are two huge pieces of rock, as samples of the material which is crushed by the immense crusher of Edison and from which the magnetic ore is obtained. On the sidewalk, near the main entrance to the Garden, is a piece of rock taken from the Edison mines, weighing 15,000 pounds. A sign states that it is a sample of the kind of rock used by Mr. Edison at his works.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., makes a very attractive display of its large line of instruments. The booth is draped in turkey red fabric, and various show cases contain samples of the different instruments produced by this well-known concern. On the back wall of the booth are arranged two lines of station instruments of different sizes. The upper line contains four illuminated dial voltmeters and ammeters, with a large potential indicator in the centre. Below this line is another containing potential indicators and ammeters on the Van Vleck edgewise system. In a showcase at the back of the booth are displayed the different parts of a Weston voltmeter, which gives an idea of the delicacy and accuracy of the construction of the instrument. In another showcase are shown ammeter shunts, the largest of which has a capacity of 3000 amperes. At the front of the booth a showcase is placed on each side of the entrance. In one of them is a full line of portable wattmeters, direct reading voltmeters for alternating current and direct current, a Weston portable galvanometer, multiplier for voltmeters, 500-ampere shunt for standard milli-voltmeter No. 9, and 1.5-15-150-ampere shunts for the standard milli-voltmeter. In the other case is a line of

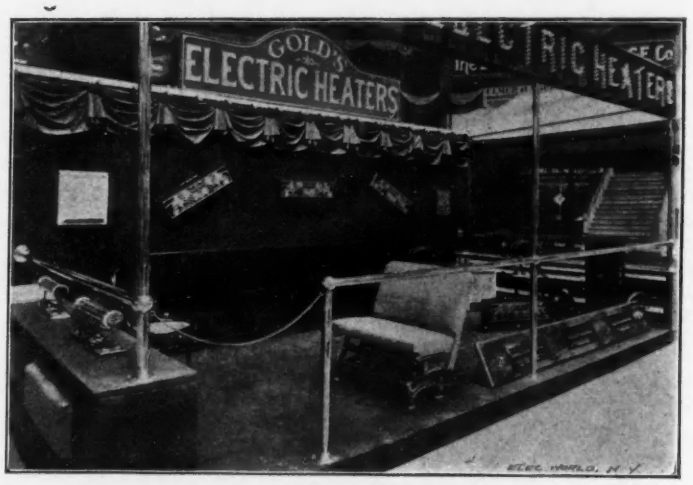


EXHIBIT OF THE GOLD STREET-CAR HEATING COMPANY.

direct reading voltmeters, ohmmeters, ammeters and a large direct reading laboratory voltmeter. This last-named instrument is provided with a thermometer on the centigrade scale and a spirit level. All the instruments in this case are handsomely finished in copper colored enamel. The new multiplying resistances for voltmeters are shown removed from the case. They consist of special high resistance alloy wire with negligible temperature coefficient wound round and round a thin mica sheet to reduce the self-induction, and shellacked thereto. In the line of special instruments a new round pattern type for therapeutic use is illustrated by a cataphoresis instrument—whatever that may be—with full scale deflection on five milliamperes. A full line of lamp measuring wattmeters is shown, and a new lamp measuring volt-ammeter, which by means of a throw-over switch indicates by the same mechanism the voltage and amperage of the lamp, the frame winding being connected with a series coil in the one case and a shunt coil in the other. A new ironclad instrument for use in the neighborhood of dynamos, etc., is also shown, this instrument being as yet not on the market. It is heavily iron clad on all sides, even under the scale, so that external magnetic fields are kept out.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

COMMUTATION IN DYNAMOS AND MOTORS. Everett. Lond. "Elec.," April 22.—Descriptions of some experiments to find the current in a coil at successive moments while the commutator bar is passing under the brush. A separately excited machine was used and a diagram showing the testing circuits is reproduced. He used a split brush on one side, consisting of two copper plates separated by an insulator, the total thickness being about equal to that of the face of a segment; these plates are joined together by a non-inductive resistance, to the middle of which one of the mains is connected, the other being connected directly to an ordinary brush covering about 1.25 segments; the two parts of the split brush are brought to the terminals of a condenser, there being in circuit a revolving contact maker which completes the circuit at any desired instant in the revolution of the armature; the condenser is then discharged through a galvanometer. Three sets of curves of results are given and the curves are explained, but it seems that no general conclusions are drawn. In a motor the brush should be moved to such a position as will bring the neutral point near the toe, while in a dynamo the neutral point should be near the heel; the brushes were always adjusted to avoid sparking; some of the curves show the variation of the current only. Similar experiments will be made with a toothed armature.

COMMUTATION IN DYNAMOS. Housman. Lond. "Elec.," April 22.—A brief reply to Sayer (see "Digest," April 30). He found from considerable experience that his views are consistent with the facts.

IRON LOSSES IN DYNAMOS. Dettmar. "Elek. Zeit.," April 21.—Some time ago (see "Digest," September 26, 1896,) he suggested a method of calculating the iron losses due to the armature current; recently he has made some tests on a rotary continuous current converter which are claimed to show that his method of calculating gave correct results: in the present long article he gives the results of these investigations. The converter which he was testing had toothed armatures, and was for converting 550-volt currents down to 110. He first determined the voltage curve, that is the characteristic, and then the power at no load for different degrees of saturation and speeds, from which the friction losses and iron losses may be determined for each voltage and speed; he then measured the energy delivered and received for a number of different loads, and finally determined the curve of the field for the various loads, and measured the armature resistances. The results are given in curves and tables. Ordinarily the iron losses are determined from two curves, one with a constant magnetism and variable speed and the other with a constant speed and variable magnetism, and from these it is possible to separate the hysteresis, Foucault and friction losses from each other; Hummel has shown that the curve for constant speed is of a quadratic nature; it may appear that the exponent should be between 1.6 and 2, but the present writer shows that it must really be about 2; the no load curve can therefore be represented by the equation that the input in watts is equal to the friction losses plus a constant times the square of the voltage of the machine, which he found to be true in about 200 curves which he took; subtracting the friction losses when the E. M. F. is zero, the iron losses will be equal to that constant multiplied by the square of the voltage; from this they may be calculated for voltages which were not observed. An equation for the iron losses in terms of the induction is given. With his method he claims that the determination of the true efficiency of a dynamo is greatly simplified. The description is somewhat involved and no general summary is given.

CARBON BRUSH HOLDERS. Scott. Lond. "Elec. Rev.," April 22.—The first part of an article in which he intends to give a few rules which govern the application of carbon brushes and to describe some of the leading types. Forty amperes per square inch is a good average for the area of contact, but some makers use as low as 25 and others as much as 60; for an ordinary wire gauze brush he found the contact density to be 200 to 115 amperes per square inch. Good conducting carbon will carry 60 to 70 amperes per square inch of cross section without getting unduly hot. He discusses the question why the substitution of a block of carbon instead of a metal brush improves the commutation.

STARTING RESISTANCES FOR MOTORS. Guilbert. "L'Eclairage Elec.," April 16.—Brief illustrated descriptions of a number of systems used; they are illustrated by diagrams which are practically self-explanatory; they have been noticed before in THE ELECTRICAL WORLD.

USES OF PHASE TRANSFORMERS. Meyer. "Zeit. fuer Elek.," April 17.—A long, illustrated article making a number of suggestions for the use of stationary phase transformers in practice.

FLY WHEEL ALTERNATOR. Bayly. "Elec. Rev.," May 4.—A short illustrated description of the new Patin alternator recently placed in a French installation. The armature is fixed and the magnets forming the fly wheel revolve around it, the engine being of the slow-speed Corliss type.

INDUCTION MOTOR PLANT.—"West. Elec.," April 30.—A brief illustrated description of what is said to be the largest and most interesting installation of induction motors in or near Chicago; it is at the works of the Deering Company.

Lights and Lighting.

WELSBACH INCANDESCENT ELECTRIC LAMP. Lond. "Elec. Rev.," April 22.—A translation of the claims of the patent, noticed in the "Digest," last week.

TRAIN LIGHTING.—Lond. "Elec. Rev.," April 22.—A translation of the editorial noticed in the "Digest," March 19.

TRAIN LIGHTING.—"Zeit. f. Beleucht.," April 20.—The first part of an extract of an article by Pohl on the practical results obtained in Germany. (It is presumably taken from the same original article as the abstract referred to above.)

ENCLOSED LAMP.—"Ziet. f. Beleucht.," April 20.—A brief illustrated description with data of the lamp made by the General Electric Company in Berlin.

Power.

CRANES. Statter. Lond. "Elec.," April 22.—A long abstract of the paper noticed in the "Digest," April 30; the present one contains a number of illustrations of some of the machinery. In discussing the relative advantages and disadvantages of the three systems of controlling he states that it is impossible to draw a hard and fast line, but that constant current and switch control cranes are about the best as to efficiency, while the clutch control system is slightly less efficient; as regards handling he believes the most accurate work is done by the switch controlled cranes, the controlling being even better when it is accomplished by displacing the brushes of a constant current motor; regarding durability the clutch controlled crane is but slightly better than the switch controlled. A constant current crane motor is shown; a constant current crane, he thinks, will prove the best in point of durability among the three types, but up to the present there is not enough experience with it to state this definitely. Regarding the cost, he states that in those requiring two or more power-driven movements the clutch controlled systems are cheaper and for many purposes they are the most suitable, but for shop traveling cranes the general preference is given for those with three motors, either switch controlled or worked by constant current; the constant current system is not more costly than the switch controlled with three motors. The conclusion states that there is no doubt that the constant current crane is a very practical form which deserves a more extended application.

UTILIZATION OF BLAST FURNACE GASES FOR ELECTRIC POWER. Booth. Lond. "Elec. Rev.," April 22.—The first part of an article in which he gives numerous figures regarding the temperature, quantity, etc., of these gases and discusses their possible use for generating electric power. The temperature is not usually far from 500° Fahr., which is not as hot as the gases from boilers; he shows that 1.5 per cent. of the total fuel is wasted in the heat in the iron; about 3 per cent. appears in the combination heat with iron and probably another 3 per cent. disappears in the slag; the waste gases contain not much less than 88 per cent. of the total heat capacity of the fuel, and this is mostly in the form of the calorific capacity of carbon monoxide, of which the gases contain about 28 per cent.; of two pounds of fuel about one pound accomplishes the purpose in the furnace and one pound remains for other purposes; for each 1.656 pounds of fuel used 1 horse-power of electric energy could be delivered at the dynamo terminals. The article is to be continued.

ELECTRICALLY DRIVEN FACTORY.—Lond. "Elec.," April 22.—A very brief description of a bicycle factory where electric driving is now being used with satisfaction.

HAMMERSTADT. Miller. "Zeit. fuer Elek.," April 17.—An illustrated description of this plant, in which the power of a water fall is transmitted 18 km at 4500 volts and a frequency of 5000 per minute, the power received being about 230 kilowatts.

ST. ANTHONY FALLS POWER STATION.—"St. Ry. Jour.," May, 1898.—A description, accompanied by numerous illustrations, of the hydraulic electric station, St. Anthony Falls, Minneapolis. The head of water has a maximum of 22 feet, a minimum of 16 feet and an average of 20 feet. The plant in use at present includes five 32-pole tri-phase, 700-kw generators, operating at 130 r. p. m. and supplying current at 3500 volts with 35 amperes, also two 8-pole direct current 700-kw generators, and two 6-pole 100-kw exciters. The shaft of each of the principal generators is directly connected to that of four horizontal 250-hp. turbines. An illustrated description of additions which have been made to this water-power plant is given in the "Elec. Eng.," May 5.

Traction.

PARIS. Collins. Lond. "Elec. Eng.," April 22.—An illustrated abstract of a long article on mechanical tramways in Paris, in which he describes all the systems of mechanical traction used in that city. He concludes that the cheapest system is the Serpollet, the total cost of which is about 45 ctm per car per km; (this is a steam engine system with a peculiar kind of boiler). The next is the electric vehicle, of which the total cost is 45 to 48 ctm per car km; sufficient information does not exist regarding the compressed air system.

CENTRAL LONDON UNDERGROUND.—Lond. "Engineering," April 22.—A continuation of the description of the machinery used in the construction of this line, in which electric power is used to a considerable extent.

TRACTION ACCUMULATORS. Niblett. Lond. "Elec. Rev.," April 15 and 22.—The conclusion of the long abstract of his paper (see "Digest," April 30). He describes the lithanoid and other batteries, giving a table of data for the former. After a brief reference to tests of accumulators he gives a short description of a few of the present applications of accumulators to carriages.

NEUCHATEL.—"L'Elec.," April 23.—A brief illustrated description of this line, in which three-phase high-tension alternating currents are transformed into continuous currents at 550 volts for running the cars.

PORTABLE ELECTRIC RAILWAY.—Lond. "Elec. Rev.," April 22.—A brief illustrated description of the Koppel system, which has already been referred to several times in the "Digest."

RAILWAY BOOSTER. J. L. Woodbridge. "Jour. Frank. Inst.," May.—A reprint of a paper read before the Electrical Section of that Institute. A description is given of the object and uses of the booster in railway circuits, with special reference to the series wound booster; the complete connections of a compound series booster are shown, the machine being simply a compound wound constant potential machine connected up "so as to get the series effect from both the series and the shunt winding;" this permits the use of a regular railway generator as a booster when required. According to a well-known law the best economy of the circuits is obtained when the average drop in volts per mile of conductor is the same throughout the entire system regardless of distance; but as the voltage should always remain above a certain minimum, either more copper must be installed than is required by this law or a booster must be used; in a great majority of cases the booster system meets the requirements exactly. The booster cannot maintain the voltage exactly, and the causes of the variation are discussed in detail; they are the saturation of the field magnets, the hysteresis, and the sluggishness due to the inductance and Foucault currents. Some diagrams are given of the results of voltage readings taken on booster lines, and these give a fair idea of what can be done with an ordinary railway generator without altering it in any way. Concerning the economy of the booster he claims that it does not really enter into the question of whether it should be used or not; only when power is very cheap is it economical to use a booster continuously; when it is used only a few times in the month for only a few hours the question of economy is obviously unimportant.

POWER STATION RECORDS.—"St. Ry. Jour.," May, 1898.—Detailed figures are given of the cost of operation of the power station of the Trenton Passenger Railway for the year 1897; the cost per car mile was .01. Figures are also given of the cost of operation of the three different stations of the Brooklyn Heights Railroad per kw hour for 1897; they vary from $0.005181 for the eastern power station, equipped with direct-connected units, to $0.009158 for the Ridgewood station, containing 300-kw belted generators.

THE CONDITION OF LOCAL, SECONDARY AND SMALL RAILWAYS IN AUSTRIA. Ziffer. "St. Ry. Jour.," Internat. Ed., May, 1898.—Great progress is being made in Austria in the equipment of the lines referred to, but certain modifications of the Government ordinances are required before the greater improvements are made. The writer gives a number of valuable tables, showing the development of the different classes of railways referred to and statistics of the electric railways.

CHICAGO. Cravath. "Elec. Eng.," May 5.—A long, illustrated description of the new electrical equipment of the South Side elevated railroad, the interesting novelties of which are the use of the multiple unit system and the cooling tower for condensing the water for the engine.

HUNT STREET POWER STATION, CINCINNATI. Baldwin. "St. Ry. Jour.," May, 1898.—This station was built in 1890, but has recently been equipped with modern machinery, the salient features of which are described by the constructing engineer. The article shows what can be done in remodeling an old plant without abandoning the original building and piping system. The engineers have devoted considerable attention to the question of stoking and have obtained excellent results with the use of automatic stokers. The new units are all of 800 kw capacity each.

POLES AND CARS IN ROCHESTER. Nicholl. "St. Ry. Jour.," May, 1898.—He describes a method of utilizing old rails as poles. The rails are placed side by side and separated from each other by blocks of cast iron. They are then held together by means of bolts. The price of these poles is a little less than that of wooden poles, and about 60 per cent. of that of new iron poles, with the advantage of utilizing the old rails.

THE OSCILLATION OF CARS. Uebelacker. "St. Ry. Jour.," May, 1898.—A continuation of a discussion on this subject, commenced by Brill in the previous issue. The writer does not agree with Brill's conclusions, but thinks that a car oscillates about a point near its centre of gravity.

THE BEST WAY OF ARRANGING RETURN FEEDERS. Nathalis. "St. Ry. Jour.," Internat. Ed., May, 1898.—A translation of the article noticed in the "Digest," April 9.

THE FIRST ELECTRIC ROAD. Henry. "St. Ry. Jour.," May, 1898.—A letter calling attention to roads built by the writer in Kansas City in 1886 and San Diego in 1897. All these roads were supplied with current from compound wound dynamos; the armatures ran continuously and were connected with the car axle by a combined differential gear and clutch running in oil; the trolley engaged the sides and bottom of the trolley wire. Several views of these early lines are given.

ENGINES FOR ELECTRIC RAILWAY POWER STATIONS. Emery. "St. Ry. Jour.," May, 1898.—A continuation of two articles published in that journal for Oct. and Jan. Engines of eight different builders are fully described and illustrated, with detailed drawings of special parts.

Installations, Systems and Appliances.

COMBINED CONTINUOUS AND THREE-PHASE CURRENT INSTALLATION.—"Elek. Zeit.," April 21.—A brief illustrated description of an installation in Hamburg, where the three-phase and continuous current systems are combined, giving the advantages of the former for motors and those of the latter for storage; the power is used largely for windlasses.

PRIVATE PLANT.—Lond. "Elec. Rev.," April 22.—A brief, illustrated description of what is said to be the most important if not the largest private installation in that country; it is in the building of an insurance company.

DARJEELING.—Lond. "Elec." and "Elec. Eng.," April 22.—A brief description of this municipal water-power plant, presumably in India. The effective head is 276 feet and the plant is for 200 incandescent lamps and two arc lamps for street lighting.

INSTALLATIONS IN GERMANY. Laffargue. "L'Eclairage Elec.," April 16.—An abstract of a paper read before the International Society on a number of installations which he recently visited.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," April 22.—An analysis of the accounts of the Westminster and the Charing Cross companies in London; they are large stations operating under very favorable conditions.

COMBINING CIRCUITS OF DIFFERENT VOLTAGES.—Lond. "Elec. Eng.," April 22.—Answers to a request for the best and most economical arrangement of a booster to allow power to be transferred between a district using 2000 volts (alternating) and another using 2400 volts; several methods are suggested.

MUNICIPAL ELECTRIC LIGHTING. Hawtyne. Lond. "Elec. Rev.," April 22.—An abstract of a recent paper. He discusses the question whether the proper persons to undertake the work are the municipal authorities or private companies; a long list of reasons is given in favor of municipalization.

ELECTRICITY SUPPLY. Gibbings. Lond. "Elec.," April 22.—In this continuation of his serial (see "Digest," April 30) he discusses the wiring and fitting of private premises by the central stations.

REGULATING THE DISTRIBUTION OF ENERGY. Rayval. "L'Eclairage Elec.," April 16.—A long discussion of a recent report by Guillain to the French Chamber of Deputies on a proposed law of the distribution of energy in France. The same issue gives the articles of the proposed law.

CENTRAL STATION RECORDS.—"Elec. Eng.," May 5.—An illustrated description of Macrae's apparatus for making records of the readings of the instruments and gauges, the records of all being made on one sheet, thus diminishing the amount of accounting necessary. The method is similar to that used in a cash register; a number of pencils, one corresponding to each instrument, are situated above a strip of paper; each pencil is moved into position, when the reading is to be taken, by means of gear wheels connected to a pointer on the dial, which is set to the position corresponding to the reading; when the readings are to be recorded and the pencils are all set, the paper is moved, while at the same time the hour of the day is recorded on it.

Wires, Wiring and Conduits.

ALUMINUM WIRES FOR OVERHEAD LINES. Russell. Lond. "Elec. Rev.," April 22.—A short article in reply to the recent (American) article by Hunt. He claims that the effect of wind pressure on the larger aluminum wire has not been considered by Hunt in coming to his conclusions, and this is then discussed by the present writer. Assuming a wind pressure of 20 pounds per square foot which is approximately the figure adopted by the post office, and that the ratio of the effective pressure on a cylindrical surface to that on a plane surface is 0.6, he compares a copper wire 0.1 inch in diameter with its equivalent in aluminum and finds that the span which will give the same dip is 155 feet for the copper wire and 162 for the aluminum; this will not save any poles, as the side strain due to the wind pressure will be 25 per cent. greater with the aluminum than with the copper wires. For a copper wire 0.3 inch in diameter the

aluminum line would require only four poles, while the copper would require five, but part of this is neutralized, as the wind strain would be 50 per cent. greater for the aluminum line, and the poles would therefore have to be made larger. Making a comparison with hard-drawn copper of 97 per cent. conductivity, he shows that the advantage as to the number of poles and side strain is with the hard-drawn copper. Moreover the expansion due to temperature is nearly 20 per cent. greater for aluminum than for copper, so that for the same dip in the summer the aluminum wire would be subjected to a greater strain in winter.

PAYMENT SYSTEMS OF HOUSE WIRING. Zingler. Lond. "Elec. Rev.," April 22.—The beginning of an article on "free and easy" payment systems, in which he discusses the two systems proposed, by means of which the distribution of the light is to be made more universal. He first discusses the one proposed by Rider (see "Digest," April 9,) and compares it with that of the National Free Wiring Company. Rider proposes that an extra sum should be paid per unit to cover the cost of the wiring, but this is very unfair to the consumer, as the percentage will rise when the price per unit is reduced, or the more electricity is used the more the customer has to pay for the wiring; he should pay a certain proportion of the actual use he gets out of the wiring and fitting rather than for the length of time that these are in his house; Rider assumed the first cost to be about $5 per lamp, but the present writer claims that good work cannot be done for this price; to spread the cost over a long time would not be acceptable to the wiring firms, and he suggests that the wiring contractor do the work and the central station give the credit for payment; he then quotes from the description of Rider's scheme.

PROTECTING THE NEUTRAL WIRE. Oxley. "Elec. Eng.," May 5.—An illustrated description of his switch, the object of which is to prevent the disastrous consequences when the fuse on the neutral wire of a three-wire system opens. The apparatus is in the form of a three-pole switch with an attachment consisting of a magnet shunting the neutral fuse, and so arranged as to release the switch the moment the fuse blows, thus opening all three circuits.

Electro-Physics and Magnetism.

PHASE SHIFTING. Schulz. "Elek. Anz.," April 21.—The first part of an article of a general character describing what is meant by differences of phase and phase shifting; it is written in an easily understood style.

EXCITATION OF ELECTRICITY. Coehn. "Wied. Ann.," 64, page 217; abstracted briefly in the "Zeit. f. Elektrochemie," April 20.—From a large number of observations he deduces the following law for the electric charges developed by the contact of non-conductors; the materials of higher dielectric constants are charged positively by contact with materials of lower dielectric constants.

OPTICAL ROTATION BY OSCILLATING DISCHARGES. Des Coudres. "Ver. Phys. Ges. Berlin," 15, No. 7; abstracted briefly in the Lond. "Elec.," April 22.—He carried the frequency much farther than 70,000 per second and shows that periods of a millionth of a second are easily followed; magnetic substances are capable of following several million reversals per second.

ABSORPTION OF WAVES BY ELECTROLYTES. Eichenwald. "Wied. Ann., No. 12; abstracted in "L'Eclairage Elec.," April 16.—He describes researches and gives the theory, showing that the results of both agree; the conductivity of electrolytes is therefore the same for constant currents and rapid oscillations and the theory of Maxwell is verified.

HALL PHENOMENON IN LIQUIDS. Bagard. "L'Eclairage Elec.," April 16.—A reply to recent unfavorable criticisms of his former conclusions. He has no reason to change his former views and concludes that this phenomenon is produced in liquids.

LENARD RAYS. Des Coudres. "Ver. Phys. Ges. Berlin," 17, No. 3; abstracted briefly with an illustration in the Lond. "Elec.," April 22.—He acknowledges the victory of the emission hypothesis of cathode rays, but doubts whether the "mass" of the cathode particle will prove to be constant and proportional to the gravitational attraction, as in the case of ordinary matter. He describes what is said to be a very interesting experiment made with his ebonite thimble for producing Lenard rays, the results of which are quite in accord with the kinetic theory; the velocity of the cathode particles depends on the potential gradient; he shows the possibility of changing the velocity of cathode rays after their emergence from the tube.

VELOCITY OF CATHODE RAYS. Des Coudres. "Ver. Phys. Ges. Berlin," 16, No. 10; abstracted briefly in the Lond. "Elec.," April 22.—He describes a method which indicates in a simple way the propagation in time of cathode particles; although ingenious, it does not seem to have been very successful. Cathode rays may be deflected by the current which produces them.

ELECTROSTATIC PROPERTIES OF CATHODE RAYS. Lenard. "Wied. Ann.," Feb.; abstracted in "L'Eclairage Elec.," April 16.—He endeavored to verify the statement of Perrin that the rods consist of negatively electrified particles.

ACTION OF CATHODE WAVES ON AIR. Lenard. "Wied. Ann.," 64, page 279; abstracted in "L'Eclairage Elec.," April 16.—The cathode rays, like those of Röntgen, have the property of making the air a conductor; researches to show this are described.

DISTRIBUTION OF FREE MAGNETISM. Holborn. "Berl. Sitzungsber.," 10, 1898; abstracted briefly in the Lond. "Elec.," April 22.—Following Mascart's method, he investigated the situation of the poles in a magnetized iron cylinder under various circumstances. He located these by means of two coils, one very short and the other very long, the effective length of the magnet being obtained from the induction impulses in the two coils induced by magnetizing the cylinder. The results for total magnetization show that the distance between the two poles of a rod 15 cm long varies between 10.8 cm and 13.7 cm, or between 0.72 cm and 0.91 cm of the total length. As the magnetizing field increases the length decreases at first, but steadily increases afterward, the minimum coinciding with the maximum of magnetic susceptibility; the change is less in wrought iron. He proved that the assumption of a magnetization first attacking the outer layers and then penetrating the inner ones, is erroneous.

MAGNETS OF SELF-HARDENING STEEL. Peirce. "Am. Jour. of Sc.," May.—The results of some tests of a large number of magnets made of some of the brands of self-hardening steel which is now in common use for lathe tools; the object was to search for a material for standard measuring magnets which would be as permanent as possible. and have a small temperature and induction coefficient. His experiments seem to show that comparatively short, seasoned, magnets made of this steel have decidedly smaller induction coefficients than magnets of the same dimensions made of tool steel; the difference in the temperature coefficient is much less, but the advantage is still on the side of those made of self-hardening steel; the temperature and induction coefficients of long magnets of the two kinds of steel do not seem to be very different. Among those he tested he occasionally found very abnormal specimens and an attempt to remedy these defects by remagnetizing failed. The results of his researches are given in curves and tables. His conclusions are that the observations on thick specimens seem to show that a thin wire of this steel would yield magnets with very small temperature coefficients.

ELECTROMAGNETIC THEORY OF LIGHT. Barus. "Am. Jour. of Sc.," May.—A mathematical article in which he shows a curious inversion in the wave mechanism of the electromagnetic theory of light. He shows that when one endeavors to reconstruct such a wave graphically one is apt to fall into a trap such as will make the wave run backwards.

Electro-Chemistry and Batteries.

STERILIZATION OF SEWAGE. Robinson, Kanthack and Rideal. Lond. "Elec.," April 22.—A brief editorial reference to their recent report on the "electrozone" process. This liquid is a product of the electrolysis of salt water, probably similar to the usual electro-bleaching solutions, and the process is therefore probably similar to the Hermite. The method of preparing the electrozone is not described; the report seems to be limited to a description of experiments made at Maidenhead. The equivalent of one grain of available chlorine was added to 4 or 5 gallons of sewage and a marked reduction in the number of bacteria was secured, but the amount of putrescible organic matter in solution was not sensibly reduced, and after four days the matter again swarmed with bacteria; it is claimed that this is satisfactory, as the bacteria subsequently formed are said to be harmless and that the treated sewage may be discharged into large streams and there oxidized before a second growth occurs; it is advisable to oxidize the organic matter by filtration and aeration and then sterilize the product with electrozone. The efficiency of this process seems to be better than that of the earlier methods, the output of available chlorine being about 33 per cent. of that calculated from the energy expended; the cost per ton of chlorine is not given and cannot be deduced from the data; in this the report is wanting.

ELECTROLYTIC REFINING OF LEAD. Cowper-Coles. Lond. "Elec. Rev.," April 22.—Brief descriptions of several processes. Keith electrolyzed the lead in sulphate of lead dissolved in a solution of acetate of sodium; the zinc and iron accumulated in the solutions. Tommasi used double acetate of lead and potassium; the silver and most of the antimony and arsenic are separated at the anode and collected in trays; the cost of operation is estimated to be 8 to 10 francs per ton of lead, using steam power. It is said that acetic acid is an expensive electrolyte, as it must be constantly renewed: the impurities are not readily detached from the cathode and holes will therefore be eaten into it. Lyte suggests converting the lead into chloride and then electrolyzing this in a molten condition; any silver is chlorinated and extracted from the mass with strong hydrochloric acid.

PRODUCTION OF PURE IRON. Gin and Leleux. "Zeit. f. Elektrochemie," April 20.—A short abstract from a French journal describing their process for the production of pure iron by decarbonizing cast iron in an electric furnace with the simultaneous production of calcium carbide. It is based on the principle that fused iron saturated with carbon, when in contact with oxides of the alkaline earths, delivers its carbon to the latter with the production of the respective carbide. The iron is first fused and then run into an electric furnace in which it is made the cathode, while the anode is a carbon rod: the required amount of the oxides of the alkaline earths is then introduced and the current is passed; the sulphur and phosphorus are freed and escape as vapors; the silica is changed into the carbide and passes into the slag.

PREPARATION OF INSOLUBLE LEAD AND COPPER COMFOUNDS. Luekow. "L'Eclairage Elec.," April 16.—Descriptions of several of his methods. (See also "Digest," Feb. 12.)

ELECTROLYTIC TREATMENT OF SLIMES. Butters. Lond. "Elec. Rev.," April 22.—An abstract of an address read before the Chemical and Metallurgical Society of South Africa, describing the treatment of slimes.

ELECTROLYSIS OF CHLORIDE OF CALCIUM SOLUTIONS. Bischoff and Foerster. "Zeit. f. Elektrochemie," April 20.—A long article describing their researches, which were intended to show the electrolytic reactions involved in the production of calcium chlorate. They show that the reactions which take place are quite similar to those in the electrolysis of solutions of alkaline chlorides.

FORMATION OF PERCHLORATES. Winteler. "Chem. Zeit.," 22, page 89; abstracted briefly in the "Zeit. f. Elektrochemie," April 20.—He shows that if in the electrolysis of the chloride solutions of the alkaline earths all of the chloride is changed into chlorate, then under certain conditions a continuation of the electrolysis will produce the perchlorates.

COSTS OF MAKING CALCIUM CARBIDE.—"Elek. Anz.," April 21.—The beginning of an article giving detailed costs of a plant.

ELECTROLYTIC PREPARATION OF GLUCINIUM.—"L'Eclairage Elec.," April 16.—Brief descriptions of several methods.

NEW GALVANIC CELLS. Pauling. Lond. "Elec. Rev.," April 22.—Descriptions of the cells noticed in the "Digest," Feb. 12.

GOLD IN SEA WATER.—"Eng. and Min. Jour.," April 30.—An editorial note correcting a previous statement (see "Digest," April 9). The latest analyses are those of Don, New Zealand, who found in six samples of sea water quantities varying from 0.061 gr. to 0.078 gr., the average being 0.071 gr. per ton, which, in the previous article was incorrectly given as 0.71. The value of the gold would then be 0.3 cent per ton of water. It is stated that this quantity is so small that the claims of those who are pretending to be treating sea water for its gold with commercial results are absurd.

Units, Measurements and Instruments.

COMMERCIAL FORMS OF ELECTRICAL RESISTANCES. Atkinson. Lond. "Elec. Eng.," April 22; abstracted at some length, but with very few illustrations, in the Lond. "Elec.," April 22.—The first part of a profusely illustrated paper read before the Northern Society of Elec. Eng. The following table of specific resistances is given, the resistances referring to a specimen 1 sq. cm, in cross section 1 cm long at 0° C. The table is to be used only as a guide, since most of the materials have somewhat undefined composition and the resistance will vary greatly with their chemical and physical condition. Concerning iron wire he states that when approaching a red heat the resistance rises so rapidly that a very large increase of E. M. F. will cause only a small increase in the current, as the resistance rises almost as fast as the E. M. F. on account of the increase of temperature. The metals, solids and liquids in this table are those most frequently used for making resistances; "relugite" is a new material having a base of asbestos on which conducting carbon is deposited and whose specific resistance can therefore be made anything desired between the limits given; liquids are in general unsatisfactory. Concerning the carrying capacity he states that it should be defined in relation to the maximum allowable temperature; this should not exceed 200° C., as most organic materials char at that temperature, the safe rule being 150° C.; the designs of resistances should allow for as free a circulation of air as possible; where wire is used the diameter should be as small as possible, so as to give greater surface; it is almost impossible to give any general rule as to the carrying capacity of wires and coils; one of the most effective forms is wire gauze cut parallel to one set of wires; when enclosed in boxes the carrying capacity will depend on the surface exposed to the air and for a temperature of 150° C. the total external surface should be about 10 in. (presumably sq. in.) per watt to be dissipated. When resistances are to be used only for a short time, as for starting motors, it is not the surface which should be considered but the total specific heat of the parts, and for this purpose materials having a high specific resistance with a large bulk may be used to advantage. Carbon resistances can be run at very high temperatures, but they dissipate heat very badly; he seems to favor those made up of plates placed in a frame in which they may be screwed together more or less tightly; the material relugite is used in this way and being flexible and elastic it has a much wider range of adjustment; larger plates of metal are interposed between the discs, serving to conduct the heat away and present a larger surface. He describes briefly a number of forms of adjustable resistances, most of which are well known and many of which are made for specific purposes; among these are some automatic methods of starting resistances. In conclusion he recommends the (American) method of manufacturing according to standards rather than to specifications.

Table of Specific Resistances.

	Resistance per cubic centimetre.	Percentage variation per deg. centigrade.
Silver	1.504 microhms.	0.377
Copper	1.598 "	0.388
Iron	9.716 "	0.453
"German silver"	20.93 "	0 03
Platinoid	51.0 "	....
"Manganin"	52.0 "	practically nil
"Eureka."	60.0 "	do
"Rheostene"	100 0 "	do
Carbon	1200-40,000 "	− 0.2
"Relugite"	3.2 to 3200 ohms	− 0.2
Solution of soda, 10% sol'n.	11.5 "	....
Do. zinc sulphate den., 1.405	28.3 "	....
H_2SO_4 density 1.10	1.37 "	− 1.7

ELECTRICAL ALLOYS. Appleyard. Lond. "Elec. Rev.," April 22.—The beginning of an article in which he will give the history of the investigation of the German Reichsanstalt concerning the mechanical and electrical permanence of the cheaper alloys used for resistance coils, the results of which led to the adoption of manganin and constantan; the article is a summary of the original report in Vol. II. of the scientific researches of that institution; a number of tables of the results are reproduced. Among the conclusions reached are that the specific resistance of german silver and nickelin can be made approximately constant by prolonged heating at 150° C., and that the specific resistance of patent nickel (an analysis of which is given) becomes within the limits of his observations perfectly constant under the same treatment, so that it does not undergo any subsequent changes when heated to 100° C.; patent nickel is essentially better than german silver and nickelin. The resistance alterations due to various influences are discussed; shellac is effective in preventing oxidation. As a result of the whole investigation it was found that german silver is of all alloys the least suitable material, since it is most influenced by mechanical deformations; nickelin, according to Klemencic, has many good properties, but its high thermo-electric power against copper and the fact that it does not withstand chemical actions are unfavorable; this alloy is very generally used for resistance boxes.

STANDARD RESISTANCES. Jaeger and Kahle. "Wied. Ann.," No. 3; abstracted briefly in the Lond. "Elec.," April 22.—A description of the calibration of the mercury tubes, the purification of the mercury and the comparison of the tubes among themselves and with manganin resistances. If filled in a vacuum, the resistances of several fillings need not differ more than a few one hundred-thousandths of an ohm; recent measurements with older standards have shown a diminution of about three one-hundred-thousandths in 4.5 years.

ELECTROSTATIC WATTMETER.—"L'Eclairage Elec.," April 16.—A brief, illustrated description of the one proposed by Guye, which is intended for measuring the power of very high voltage currents. The apparatus is very simple, and is based on the principle of the Curie wattmeter. In appearance it is like the quadrant electrometer, only that instead of quadrants there are semicircular sectors, the needle being also divided into two semicircles, the division line between the two being perpendicular to that of the case; the needle is mounted on knife edges and can be weighted to reduce the sensitiveness, gravity being the directing force; the two parts of the needle are connected through their supports to the ends of a known inductive resistance; the force is proportional to the sine of the angle of deflection.

CIRCUIT BREAKER. Cremieu. "Elek. Zeit.," April 21.—A German abstract with the illustrations of the paper noticed in the "Digest," April 9 and March 19.

MEASURING THE INTERNAL RESISTANCE OF GALVANIC CELLS. Haagn. Lond. "Elec. Rev.," April 22.—A brief reference to the continuation of his researches (see "Digest," June 19 and July 31, 1897). He determined the resistance of cells with small polarization capacity. If the branches of a Wheatstone bridge are 1, 2, 3 and 4, the two latter being the bridge wires, and if the branches 1 and 2 contain in addition capacities, balance is obtained when the resistances 3 and 4 are to each other inversely as these two capacities and when at the same time the bridge resistances are balanced. He uses the telephone method: a suitable condenser may be made by immersing two aluminum plates in sulphuric acid of maximum conductivity and passing current between them at about 10 volts for a minute, which will polarize the plates so that with anything smaller no current will pass in that direction, a condition which will be retained for a considerable period; the capacity of the condenser is varied by changing the depth of immersion; the method is applicable whether a current is flowing through the cell or not.

NEW METHOD OF MEASURING INTENSITIES OF MAGNETIC FIELDS. Bouty. "L'Eclairage Elec.," April 16.—The first part of a mathematical article giving the theory of his method, which was briefly described in the abstract noticed in the "Digest," March 5 (see also last week).

MEASURING THE EFFICIENCY OF DYNAMOS. Dupuy. Lond. "Elec. Rev.," April 22.—A translation of the article noticed in the "Digest," Feb. 19.

MEASURING EARTH CURRENTS IN THREE-WIRE SYSTEMS.—Lond. "Elec. Eng.," April 22.—Answers to a request to show how the actual amount of earth on the positive, negative and neutral wires may be found without shutting down any portion of the system.

NEW THERMO-PILE FOR TEMPERATURE MEASUREMENTS. Rubens. "Zeit. f. Instrumentenkunde," March; abstracted briefly in the Lond. "Elec.," April 15.—The reason why the old thermo-pile has been replaced by the bolometer and other instruments, he thinks is due to its great thermal capacity, which makes the reaction slow and uncertain; the remedy for this is to make the elements of thin wires, and he therefore suggests constantane-iron couples which can be drawn to fine wires, although they have only one-half the E. M. F. of the other combinations; the wires are 0.1 mm thick; a pile contains twenty joints 1 mm apart, and forms an excellent receiver for spectrum lines; it has an E. M. F. of 0.00106 volt per degree C., and an internal resistance of 3.5 ohms; with a sensitive galvanometer differences of temperature of one millionth of a degree may be observed; it has a much better zero stability than the bolometer.

THEORY OF INDUCTION COILS. Armagnat. "L'Eclairage Elec.," April 9.—A long article describing his theory, which he says he published four years ago, and which is identical with that of Walter, recently published in the "Wied. Ann.," but some of the experiments described by the latter do not agree with some of those of the present author; these are described. No general conclusions are drawn.

Telegraphy, Telephony and Signals.

TELEGRAPHING ACROSS SPACE. S. P. Thompson. Lond. "Elec. Eng.," April 22.—The conclusion of his paper (see "Digest," last week). He discusses the wave methods. In his conclusions he believes all three methods may be developed so "that by any one of them it will be possible to establish electrical communication between England and America across the intervening space. It is certainly possible either by conduction or by induction; whether by waves I am somewhat less certain." He believes it to be certainly possible by conduction or induction to establish direct communication with either the Cape or India or Australia, at a far less cost than that of a connecting submarine cable. It must be recognized that the base line or the base area surounded by wires is a fundamental necessity, and that real syntony must be established between the sending and receiving parts to make it sensitive and independent, as without these conditions such systems would become too costly and unmanageable for commercial needs. In the Lond. "Elec.," April 22, he replies to the criticisms of Wilkins (see "Digest," last week,) and claims that he was misquoted.

WIRELESS TELEGRAPHY—Lond. "Elec. Rev.," April 22.—An article on the experiments that are being conducted in England by Marconi. Some quotations from Slaby are made, in which he acknowledges that Marconi has made a discovery and gives some of his own experiences; among these he states that he omits the silver entirely in the filings and uses only nickel; it is unimportant to exhaust the tubes after filling, but it is well to seal them hermetically. The present experiments are being made between Bournemouth and the Needles, a distance of 14.5 miles; messages are being sent between these points with facility and accuracy; the pole is about 115 feet high; some code test messages came back exactly as they were sent; these experiments have been conductd for some months, and it was shown that variations in the weather had practically no marked effect, foggy and stormy weather, if anything, being favorable; signalling had also been carried on between a ship and the shore in the very worst weather, the mast of the ship being 50 feet high. The next test will be made from Swanage to the Needles, a distance of 18 miles, and after that across the Channel to Cherbourg, a distance of 60 miles.

RECEIVER FOR WAVE TELEGRAPHY. Rupp. Lond. "Elec. Rev.," April 22.—An abstract of the article noticed in the "Digest," last week, including an illustration of the coherer and a diagram of the local circuits.

TELEPHONE STATISTICS.—Lond. "Elec. Eng.," April 15.—A comparative table of telephone rentals for the leading countries, chiefly in Europe. It is said to be correct to February of this year. A table of the number of inhabitants per telephone is given for the chief countries of Europe, the least being in Sweden, namely, 115, followed by Switzerland with 129; England is not included.

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.—"Zeit. fuer Elek.," April 3.—A few remarks by L. K. on the conclusions arrived at by Picard and Cailho.

TELEPHONE SYSTEMS OF THE UNITED KINGDOM. Raphael. Lond. "Elec.," February 4 and March 4.—A continuation of his long serial, (see Digest Jan. 1).

PACIFIC CABLE.—Lond. "Elec. Eng.," April 15.—A reprint of an article from the London "Times," which is said to be a most valuable one.

DIRECT CABLE FROM SPAIN TO CUBA.—"Elek. Zeit.," April 21.—A note from a Spanish paper stating that the matter is being considered favorably by the Spanish minister. The cable is to go from Cadiz to Santa Cruz on Teneriffe, and from there to the island of Nicques, and then to Havana. The reason it is not laid directly to Havana is because a French cable company has the exclusive right for forty years to lay cables in that city.

EXTENDING TELEPHONE CIRCUITS. Heina. "L'Eclairage Elec.," April 16.—An article discussing the various ways of extending telephone circuits in a city, with special reference to the system of combining the circuits at suitably chosen points and from there running underground circuits to the central station.

INDUCTANCE IN TELEPHONY. Moon. Lond. "Elec. Rev.," April 22.—The conclusion of his article (see "Digest," last week). No general conclusions are drawn.

SYNCHRONOGRAPH.—"Jour. Frank. Inst.," May.—The discussion of the recent paper (see "Digest," March 26,) concerning the tests made by the British Government. Stine praised the beauty and exceeding simplicity of the method; he doubts the practical value of the photographing registering device; he claims the receiving apparatus is too complicated to compete with other systems, the chief obstacle is the time constant of the circuit; the method of rectifying the wave is open to criticism. Houston and Kennelly discuss the result that the effective speed of alternating currents was three times as great as with those of a rectangular type, the result being a very interesting one, but the disparity between the value of the E. M. F. in the two cases somewhat invalidates the comparison; the allowance that should be made for the great variation of the E. M. F. will probably be considered; they admit that it seems remarkable that so great an improvement in speed should be obtained with a sinusoidal E. M. F.; it would be interesting to find out what could be obtained with sinusoidal E. M. Fs. over submarine cables in which the relation of inductance to capacity and of conductor resistance to insulation resistance is relatively so small that the product of capacity and resistance is the true criterion of the slowness of transmission; as the conditions here and in Europe are so different, they doubt whether government control here would be of benefit to the people. Fessenden praises the apparatus very highly, and said it was capable of fulfilling all demands upon it; practically the capacity of a single wire may now be considered infinite; the large telegraph companies in this country do not want improved apparatus unless there is danger of the formation of a competing company; he approves of the Government taking up the telegraph; the transmitter he considers perfect, but he points out the defects in the present apparatus. Delany discussed the question of sparking, synchronism, legibility, etc.; there are difficulties in the way of applying sinusoidal currents which seriously offset the advantages; the use of a negative record is utterly impracticable; the experiments in England are discussed, and he regrets that no specimens of the work were reproduced; the present instrument can record only complete waves, and although the frequency is greater, it does not follow that the speed of recording letters or words is raised in a proportionate degree; comparisons of speeds on the basis of frequencies is most misleading; self-induction should be used to reduce the tailing effect, and the dots and dashes should be separated into different lines, so that this effect may be disregarded.

AUXILIARY TELEPHONE SIGNALS. Clausen. "West. Elec.," April 30.—A short, profusely illustrated article describing the auxiliary apparatus in telephone exchanges.

Miscellaneous.

RIVETING BY ELECTRICITY. Kodolitsch. Lond. "Elec.," April 22.—An abstract of the paper noticed in the "Digest," April 23; the present abstract is longer than the one noticed before. He shows why the electric system, from a commercial and technical point of view, is superior to its rivals. The initial outlay is far less and the cost of maintenance is a mere fraction; there is not the slightest difference in the quality of the work, but in regard to quantity the electric system is considerably superior; for many weeks 1200 rivets per day of twelve hours were closed with the aid of three men and a boy. The machine can easily be carried about from place to place. A disc is rotated by an electric motor whether riveting is done or not, and this is then coupled electromagnetically to a screw spindle which attaches it firmly to the revolving disc: thus the friction of the screw spindle can be regulated by the operator, and moves a large nut at the end of a knuckle joint which raises and lowers the die for making the rivet head. It closes rivets up to 1⅛ inch in diameter. The abstract is reprinted in "El'ty," (N. Y.), May 4.

ELECTRICAL JOURNALS.—"Elec. Tech.," April 15.—A note stating that the number of journals in the world devoted exclusively or chiefly to electricity is sixty-six, of which eighteen are published in France, fourteen in the United States, twelve in Germany, six in England, three in Switzerland and two each in Austria, Belgium, Holland, Italy, and Spain. The names of these journals are not given. (There is also one in Japan.)

INDIA RUBBER. Morris. Lond. "Elec." and "Elec. Eng.," April 22.—A brief abstract of the first two of his Cantor lectures on the sources of commercial india rubber.

STERILIZATION OF WATER BY OZONE. Andreoli. "L'Elec.," April 9.—An extract and discussion of a recent report by Gerard on the electric processes of the purification of water by ozone. In this it is claimed that the Tindal apparatus was used at the Brussels exhibition regularly, and at the rate of 50 to 75 watts per cu. m. of water. The apparatus is not described, but some data is given; the high tension current from a transformer is passed through a liquid resistance and then to the apparatus, where the silent discharge takes place and where it acts on a current of dry air

which is afterward passed through the water. The method of determining the quantity of ozone is described. From a table of results it appears that the circulation was 2400 liters of air per hour, that the concentration of ozone was from 3 to 4.3 gr. per cu. m. of air, or at the rate of 252 watts (watt hours) per gram of ozone. The result is criticised, as it is claimed that one ought to obtain 20 to 25 gr. from one-quarter of a kw, instead of 1 gr.; theoretically the amount is 1030 gr. per hp-hour. The electrodes in this apparatus are not separated by a dielectric plate. The report states that one can calculate on about one-ninth to one-eighth of a hp (hour) per cu. m. of water purified, or about 85 to 95 watts (watt hours). Thus the cost is only 0.16 to 0.2 cents per cu. m., which price could be reduced to half in a properly established installation.

FATALITIES DUE TO ALTERNATING CURRENTS.—"Zeit. fuer Elek.," April 10.—A note stating that in Magdeburg, Germany, two workmen came in contact with some electric circuits and were immediately killed; the current was an alternating one, the voltage in one case was 130 and in the other 230. An employee of the station took the current in the same way through the body without serious consequences. According to the views of some physicians the human body is especially sensitive to electrical currents when under the influence of alcohol; it is therefore suggested not to employ those addicted to the habit of drinking, especially in connection with alternating current installation.

ELECTRIC HEATING. Le Roy. Lond. "Elec. Rev.," April 15.—A short abstract, though in part not very clear, of a recent paper read before the French Society of Civil Engineers. He experimented with crystallized silicium or graphitoid, which alone gives the results he desired for the construction of a simple and convenient domestic apparatus; (this has already been referred to in the "Digest"). He gives the mean relative prices of various kinds of fuel for heating and describes his system, which consists essentially of an "electric block which is constituted of a rod of pure silicium agglomerated and enclosed in a glass tube suitable for subjecting it to oxidation"; the block should be brought to a temperature of about 1100°, probably C.°

HEATING APPARATUS. Helberger. "Elek. Zeit.," April 14.—An abstract of a recent paper describing his systems of electrical heating apparatus.

LOW WATER ALARM.—Lond. "Elec. Eng.," April 15.—An illustrated deescription of a device which consists essentially of a mercury thermometer into which two platinum wires are fused and which are connected by the mercury rising to a certain height, the thermometer being plated in a tube leading into the boiler at the low level line; when the boiler is full of water, the water is in contact with the thermometer and the temperature is therefore not sufficient, but as soon as the low level is reached the tube fills with steam, which is hotter and makes the necessary connection.

BIOGRAPHICAL.—"Zeit. fuer Elek.," April 3.—A short biographical sketch accompanying the obituary notice of Wladimir Nikclajewitsch Tschikoleff, the well-known Russian pioneer in the electrical field, who died in St. Petersburg March 6 at the age of fifty-four. He was the original inventor of the differential arc lamp.

ACCUMULATOR FACTORY. Wetzler. "Elec. Eng.," April 28.—A very long, profusely illustrated article describing the factory of the Electric Storage Battery Company, making the Chloride accumulator, and including brief descriptions of some of the installations.

OMAHA EXHIBITION.—"West. Elec.," April 23.—An illustrated description of the Machinery and Electricity Building of this exhibition.

Intercommunicating Telephone System.

Within the last few years quite a number of intercommunicating telephone systems have been placed on the market for use in hotels, business blocks, factories, warehouses, etc., and for all of which special and important claims have been made. The firm of Plummer, Ham & Richardson, of Worcester, Mass., has been for some time identified quite prominently with telephone work, and has recently introduced an intercommunicating telephone system which seems to possess some worthy and excellent features. We illustrate herewith two intercommunicating instruments of this firm to be used in connection with any number of stations, one employing a magneto call and the other a battery call, both styles being provided with the well-known Swedish transmitter; also an automatic replacing sectional switch. The instruments as shown are of neat design and compact, and are made of first-class material. This system is installed in the State Lunatic Asylum, Worcester, Mass., 61 stations; new City Hall at Worcester, 20 stations; Isaac Prouty, Spencer, Mass., 30 stations, and the Draper Company, Hopedale, Mass., 31 stations. There are quite a number of other prominent installations, all giving perfect satisfaction.

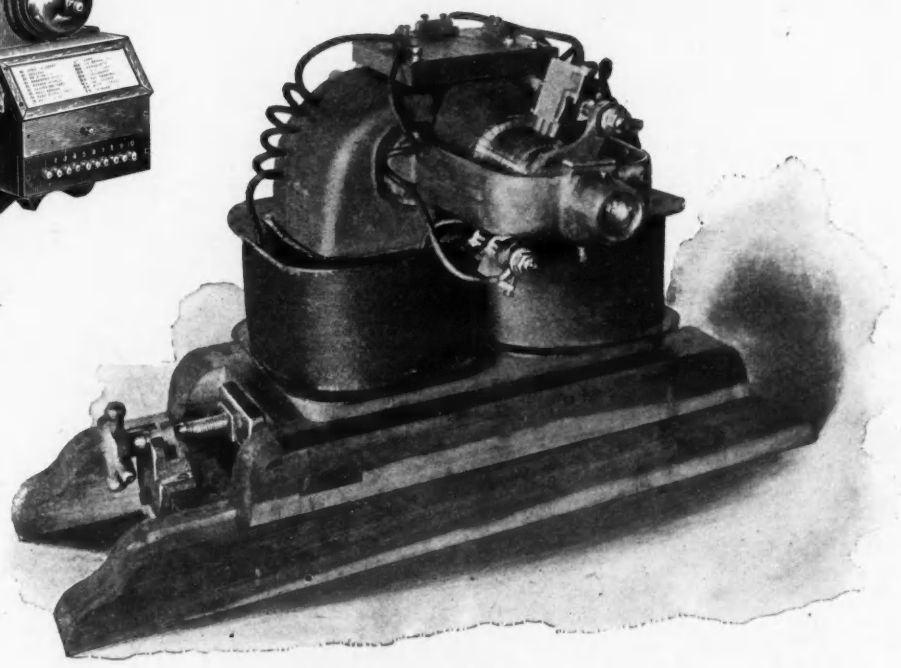
Direct-Current Dynamos and Motors.

The direct-current dynamos and motors made by the Rochester Electric Motor Company, Rochester, N. Y., have been on the market for two years and have, it is said, established a record for efficiency and durability. They are fitted with sectional wound armatures, interchangeable field magnet coils, and self-oiling bearings. Extra heavy insulation is used in their construction. The magnets are cast in one piece. The brushes are a combination of carbon and copper gauze. These machines are excellently adapted to belted or geared service. They are built in sizes from one-fourth to 25 horse-power. The generators are wound compound, and the motors either series or shunt, for 110, 220 or 500 volts.

The accompanying illustration represents a 3-hp motor for belted service, and illustrates the type of machine from ¼ to 5 horse-power. Above 5 horse-power uprights are used in place of yokes for bearing supports. Automatic starting boxes are supplied with motors over 1 horse-power. The speed of the ¼-hp machine is 1600 revolutions, and that of the 25-hp machine 350 revolutions.

The Rochester Electric Motor Company warrants its machines as to efficiency and thoroughness of construction.

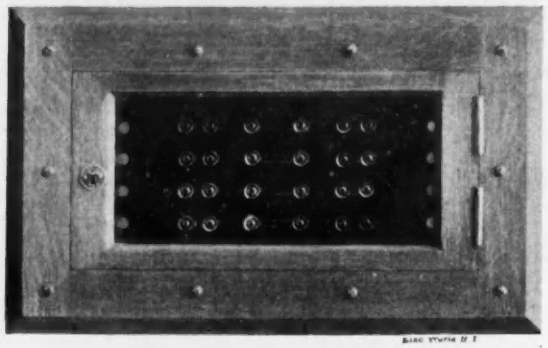
INTERCOMMUNICATING TELEPHONES.



3-HP MOTOR FOR BELTED SERVICE.

Improved Junction Boxes.

A line of junction boxes is being brought out by Messrs. Johnson & Morton, Utica, N. Y. The boxes are furnished in cast iron or oak, as desired, and in either case are slate lined throughout, effectually preventing any grounding or danger from fire. The slate lining is enameled and all copper work showing in the box is highly polished and lacquered. All boxes are provided with the firm's patented wiring-pocket back of the tablet board, which permits the mains and branch circuits being brought into the box at any convenient point without interfering with its appearance when connected

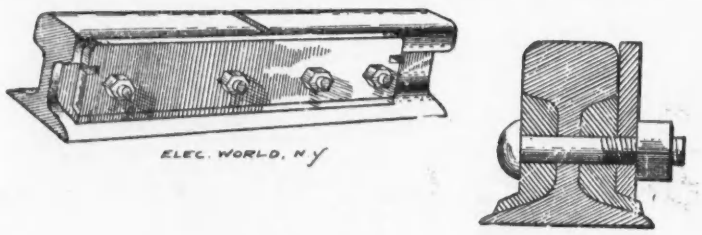


Junction Box.

up. The boxes are made in two types, the D type having the door opening the full size of the box and arranged to receive a main knife switch or branch knife switches, or both. The O type box has the door opening only wide enough to make the fuses accessible, and is arranged to contain the main knife switch, and any type of flush switches mounted on the cover. Either type of box can be furnished with meter connections arranged so that the entrance wires are brought to the main switch and cut-out, current going thence to the meter and bus bars of the box. This arrangement complies with the requirements of the fire underwriters for entrance switch and cut-out, and enables the meter to be placed where most convenient. The box covers are made to project one inch over the edge of the box, so that when set flush the broken plaster edge is covered. The covers are finished solid or with plate glass panel, as desired, and all are supplied with lock and key.

A Rail-Joint Bridge.

The accompanying illustrations show an ingenious method of avoiding the pounding of rail joints, which is such a serious factor in electric street railroads, with their rigid road beds and frequent service. The bridge consists



Rail-Joint Bridge.

of a plate mounted on the outside of the rail over the ordinary tie plate. The upper edge of this bridge is flush with the surface of the rails, so that the wheel tread runs upon it and is carried over from one rail to the other without pounding on the point. This bridge rests upon either the foot of the rail, or, in case the fish plate has a lower flange, on the latter. This bridge can be used on old roads where the joints have been bent or dropped to such an extent that the pounding rapidly bends the rail still further and depreciates the rolling stock most seriously. Some of these bridges have been in successful operation for over a year without repair on the Pasadena & Los Angeles electric road in Pasadena, Cal. The patentee of this device is Mr. Otis T. Bedell, Cairo, Greene County, N. Y., and the bridges are constructed by the Jersey City Spike Works, Jersey City, N. J.

"Knockout" Outlet and Junction Box.

With the introduction of iron conduit for the interior wiring of buildings the matter of mechanical connections became an important question, to meet which various styles of outlet boxes, junction boxes and appliances for attaching these boxes to the iron conduits have been placed on the market, and all of which have attracted more or less favor with electrical contractors and architects.

The Chase "Knockout" and outlet junction boxes and the Chase nipple met with good favor in the trade, and as improvements have been made from time to time in the light of experience it would seem that the various types of boxes and appliances now manufactured by the L. A. Chase & Co., Boston, will conform to almost any requirement and exigency connected with interior iron conduit work.

The Chase boxes are made of special grade of metal, and heavily coated with a hard enamel having the best insulating qualities. The boxes are so constructed as to have, at frequent intervals on their surface thin webs or films, which a slight blow of a hammer will "knock out," leaving round holes for outlets in as many combinations as are generally required.

The method of attaching the box to the conduit is new, and has many advantages. A hollow bushing or nipple, which is threaded on the exterior and smooth and insulated with enamel on the interior, is passed through the hole made in the box at the point desired, and screwed into the coupling on the end of the conduit. This makes a perfect mechanical connection, which can be made watertight. By means of this nipple wires can be readily pulled through the tube into the box without any danger of abrasion or injury to the insulation of the wires. This will prevent the frequent and troublesome grounding so often met with in outlet boxes.

One great objection to many of the boxes in general use is the impossibility of removing them, if broken or injured, without removing considerable other work that has been completed. The Chase boxes can be instantly disconnected from the conduit by unscrewing the nipples from the inside of the box, thus allowing the box to be withdrawn, regardless of the number of conduits that enter it.

The disadvantage of using boxes made from steel is entirely overcome by the use of the Chase boxes, which are stiff and will not bend and destroy

Fig. 1.

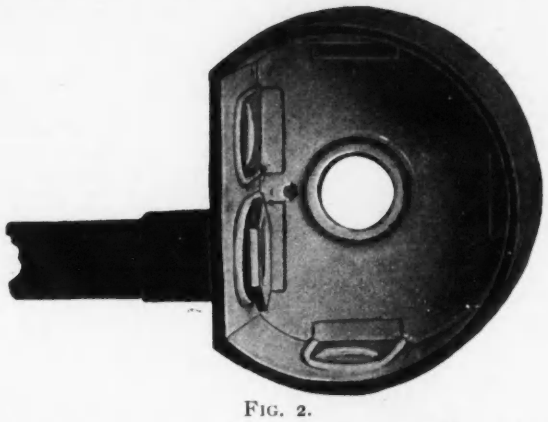


Fig. 2.

Fig. 3.

the thread on the conduit, but are adjustable and will allow more or less movement, so that the box can be properly leveled in place and then made up tight in its proper position. It also obviates using left-hand threads, which will be readily appreciated by the contractor, as a large saving in labor and allowing much neater work to be accomplished.

Fig. 1 represents the Chase ceiling outlet box, which may be used for the outlets where the conduits enter from the side or the back of the box. The hole in the centre of the box allows for a support for the fixture, or, if used in combination work, the gas pipe nipple, to come through. However, in combination work it may be preferable to have a sleeve to prevent the gas

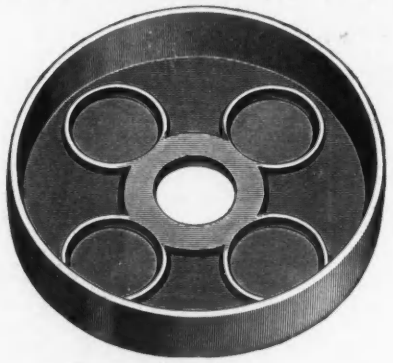


Fig. 4

Fig. 5.

pipe from coming in contact with the wire. For straight electric work, where no gas pipes are used, this may be used also for a wall outlet.

Fig. 2 is designed for a wall box where two conduits enter, both on the same side, which is a very common occurrence. This box can also be used to good advantage as a ceiling box when outlets come on the bottom of iron beams. The diameter being small, allows the use of ordinary fixture shells.

Fig. 3 is a box of practically the same style as the wall box, with the exception that it has a recess in the bottom, so that it will straddle the tee of the gas pipe at the outlet. This is a very desirable feature in places where the plaster comes close. The diameter being small, allows the use of ordinary fixture shells.

Fig. 4 represents the Chase ceiling box to be used on terra cotta work where all outlets enter from the back. This box is three-fourths of an inch high, and the diameter being small, allows the use of ordinary fixture shells. Covers can be supplied for any of the above boxes if desired.

Fig. 5 represents the Chase nipple which is meeting with so much favor among electrical contractors. It is constructed from a special grade of metal, having an exceedingly tough nature, and is made with a hexagon head, which allows the nipple to be easily screwed into coupling on the end of the conduit. The nipple is thoroughly coated with a special enamel that adheres firmly to the metal and will not chip off. In drawing in the wires the nipples are of special advantage, as they prevent abrasion and the wires are drawn much easier. These nipples can also be used to great advantage at outlets where boxes are not to be used.

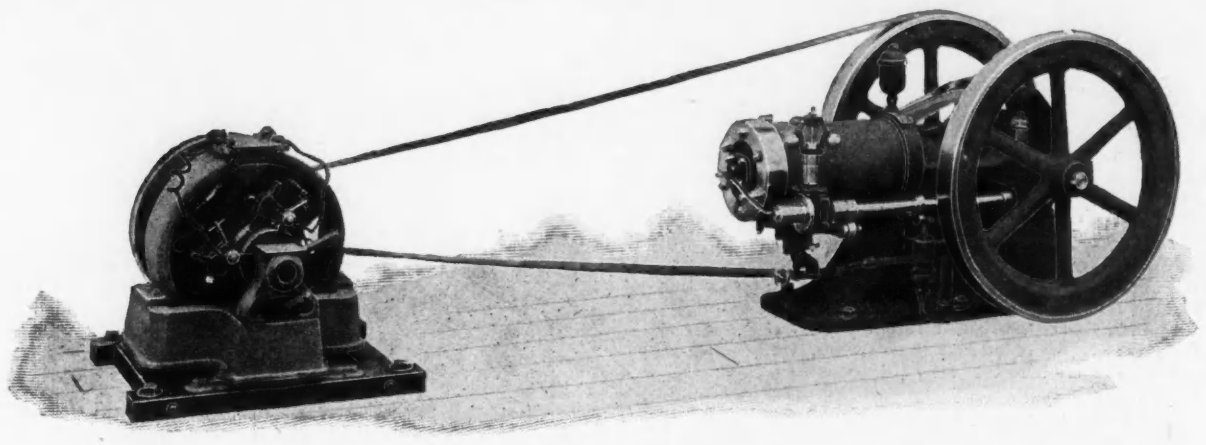
Gas Engine for Dynamo Driving.

Gas engine plants for isolated lighting in factories and stores have shown themselves to be so simple in operation and economical in maintenance that they are rapidly growing in favor with all users of light. To meet this growing demand, the Hobart Electric Manufacturing Company, Troy, Ohio, adapted its dynamos especially to work with gas and gasoline engines.

The accompanying illustration represents one of this company's multipolar machines belted direct to a gas engine. The absence of countershafts and extra belting is a noticeable feature. The fly wheel is mounted direct on the armature shaft, so that the armature speed is constant, although that of the engine may fluctuate considerably between explosions. Where the engine speed is ordinarily good the fly wheel is also dispensed with.

The expense of operation in a plant of any considerable size is said to be very low, as has been demonstrated by reports from those who have been using the Hobart dynamos in this way. The firm recently took occasion to obtain reports from the plants that it has installed, and reports finding that it costs from 3 to 10 cents per month per lamp, in places where the light is used every night, and all the lights burning.

These plants find their way into all classes of factories and stores, such as grocery stores, drug stores, shoe stores, dry goods houses, etc. Wherever used they have worked perfectly satisfactorily. The reports, the company states, show that the plants pay for themselves in from two to three years.



DYNAMO BELTED TO A GAS ENGINE.

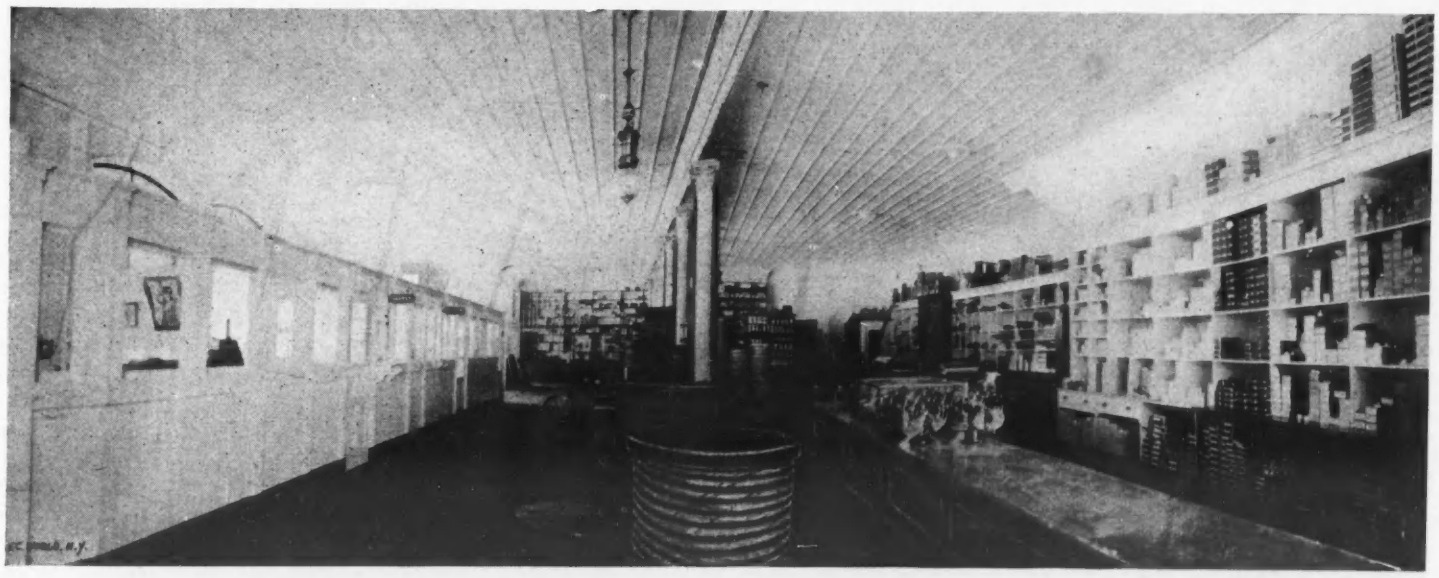
A Prominent Boston Electrical Supply House.

The Pettingell, Andrews Company's new quarters, in historic Winthrop Square, No. 5, and also No. 275 Devonshire Street, Boston, Mass., right in the heart of business interests in the immediate vicinity, and only a few moments' walk from its recent Federal Street quarters, afford a home of which it may well be proud. In magnitude, general appearance and arrangement the new home is at once impressive and striking, both from the exterior and interior. Upon entering, the visitor is attracted by the long line of private executive and business offices, which include, first, that of president, treasurer and secretary; second, bookkeeping department; third, purchasing department; fourth, stenographers' department; fifth, freight and teaming department, and sixth, the telephone booths, long distance and local. Another attraction is the thousands of feet of Okonite wires and cables, tons of line and feeder wires for electric light and railway purposes, Lundell fan motors, all styles in full operation, arc lamps in circuit, handsome display of electrical supplies—embracing all the various appliances used in the different branches of the electrical industry—and the increased facilities, everywhere manifest, providing for quick attention, prompt shipments and delivery.

The accompanying illustration presents a partial interior view of the offices and salesroom of this establishment, which for equipment is declared to be the equal, if not the superior, of any electrical supply establishment in existence.

The history of this company is one of progress, and its new home is a happy and deserved result of well directed energies and strict business methods and integrity. Guided as it has been by gentlemen comparatively young in years, its success is all the more deserved and affords a handsome tribute to the younger element which has been all along and is still so conspicuous in the electrical business. The company's officers are all well and favorably known and extremely popular. President and general manager, Charles B. Price; treasurer, D. A. Andrews, Jr.; secretary, F. S. Price, who with two others, notable business men, comprise also the board of directors.

The company represents exclusively in New England the Okonite Company, Sprague Electric Company, Phillips Insulated Wire Company and Bryant Electric Company, and it carries also in stock every known electrical specialty from the smaller to the greater nature. Its business has grown to enormous proportions, its railway department having shown particularly rapid growth, as well as the wholesale department, which includes the furnishing of raw material to manufacturers.



OFFICES AND SALESROOMS OF A PROMINENT BOSTON ELECTRICAL SUPPLY HOUSE.

NEWS OF THE WEEK

Financial Intelligence.

THE ERIE TELEGRAPH & TELEPHONE COMPANY has declared its regular quarterly dividend of 1 per cent., payable May 16.

THE BELL TELEPHONE COMPANY of Philadelphia will meet on June 22 to vote on the question of increasing the capitalization from $2,000,000 to $4,000,000.

THE CHICAGO EDISON COMPANY'S report for the year ending March 31, 1898, shows a gross income of $1,661,863, an increase of $113,255, as compared with the gross income of the year previous. The operating expenses were $985,338, an increase of $36,404. The regular dividend of 8 per cent. was maintained, and a balance of $51,772 carried forward, against $21,822 the year previous.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, May 9, 1898.

MR. R. C. DEMARY, Buffalo, N. Y., was in New York during the past week.

MR. ROBERT J. PARVIN has succeeded Mr. W. F. Osborne as Eastern manager of the "Western Electrician." The office of the paper has also been changed from the Times Building to Room 809, Postal Telegraph Building, New York.

JUSTICE SCOTT in the Supreme Court, on May 3, denied the application of Thomas E. Leeman, one of the minority stockholders in the Municipal Electric Light Company, of Brooklyn, for a mandatory injunction, pending trial, to restrain the Edison Electric Illuminating Company of Brooklyn from carrying out a plan of reorganization.

ANOTHER CONDUIT ROAD OPENED.—Electric cars were put into service on the Eighth Avenue line of the Metropolitan Street Railway Company on Saturday, May 7. The cars run from Fifty-ninth Street to Central Bridge at One Hundred and Fifty-fifth Street. Transfers are issued at One Hundred and Sixteenth, Eighty-sixth and Fifty-ninth Streets to all connecting lines. Excepting the Twenty-third Street cross-town line, the Eighth Avenue line completes the improvements the Metropolitan Company last summer started out to make.

WEEKLY LECTURES, the dates of which will be duly announced, will be given by the New York Electrical Society at Madison Square Garden during the Electrical Exhibition. These wil frequently be supplemented with other lectures of special interest to the members. The booth of the society at the Garden will have a register for the signatures of visitors; will serve as a rendezvous for members and their friends, and also as a bureau of information, which will be available from 7:30 to 10:00 o'clock every evening. Half-price tickets can be had at the booth every evening between 8 and 9 o'clock, and from Secretary Guy, whose office is at 120 Liberty Street.

NEW ENGLAND NOTE.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 399 Atlantic Ave.,
BOSTON, Mass., May 7, 1898.

MESSRS. PLUMMER, HAM & RICHARDSON, 619 Main Street, Worcester, Mass., who have been for some time New England agents for the Ericsson Swedish telephones, and also engaged in the manufacture of telephone apparatus and supplies, have just issued a neat catalogue of eighteen pages, covering not only the various types of Ericsson telephones, but also a number of its own telephone manufactures, embodying both independent and intercommunicating systems. This telephone catalogue will be sent to anyone on application, and will doubtless be accorded the hearty reception it deserves. Plummer, Ham & Richardson also carry a large line of general electrical supplies, being also contractors for all classes of electrical work. Messrs. Plum and Ham are both practical electricians, and Mr. Richardson, who has only recently joined the firm, has hitherto been associated in prominent business lines in Worcester.

SOUTHERN NOTE.

WASHINGTON, D C., May 7, 1898.

THE TELEPHONE FIGHT.—Over seventy druggists have ordered their telephones taken out and the roof wires cut because the Chesapeake & Potomac Telephone Company has refused to lower its rates or amend its regulations, which the druggists think are too restricted. The druggists are backed by the Pharmaceutical Association. Many of the most prominent physicians in the city are also interested in the warfare between the company and the druggists. It is stated that they also have demanded lower rates, and in the event of refusal to comply with the demand 188 of them will order their telephones taken out. The telephone company has refused to deal with the Pharmaceutical Association as a body on the ground that it does not rent its telephones to the druggists as members of a body, but as individual persons.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y , May 7, 1898.

A STRIKE of the iron workers on various buildings under construction in the city has somewhat delayed work on the Buffalo General Electric Company's new lighting station.

THE BUFFALO TRACTION COMPANY is on its feet again, having succeeded in selling its Kenmore line to the new Lockport road and won its fight for possession of Utica Street, which will be made the main crossing over point uptown, similar to Twenty-third Street, in New York. All construction work had been stopped by the litigation, but it will soon begin again.

THE SCHOELLKOPF HYDRAULIC COMPANY at Niagara Falls is just finishing the installation of a set of six new Westinghouse generators of 2000 horse-power each in the power house below the mill district. One will be put in operation at once, and the others as they are needed, to furnish power for mills in the vicinity. Unlike the machinery at the Niagara tunnel it is all at the bottom of the gorge, the turbines and generators being close together.

IT IS KNOWN that the Niagara tunnel authorities are steadily at work preparing plans for increasing the capacity of the electric plant on the Canadian side of the Niagara, but this is in reality little more than bluff meeting bluff, as it is stated without reserve that there is already available in the power house of the electric railway in Victoria Park 1000 horse-power that cannot be sold. When it was feared that no use would be made of the grant from Canada to the tunnel company a great outcry was raised, but when the power is offered it is not taken.

THE WAR has put a stop, for the present, to all development in industrial enterprises. No new Niagara power contracts have been made yet, unless it may be said that the problems presented in the equipment of the Urban flour mill are solved, in which case the contract may be said to be complete. A decided quietus has been placed on all the suburban trolley building. As a rule the people interested in this work are saying very little about it just now, and those who were sure of a road right away are now mostly talking about next year. The reason is said to be that the demand for money is so great that capitalists prefer to keep it on demand in New York rather than tie it up in permanent investments.

THE PASSING of the Lockport branch of the Erie Railroad from Tonawanda into the hands of a new trolley company by a long lease is now officially announced. A local paper declares that it is the beginning of the conversion of all short steam lines into similar lines. This line is to reach Buffalo by the old Kenmore line, instead of the Ely line to Niagara Falls, as was at first supposed. Stockholders of the Ely road control the new venture, however, and W. Caryl Ely has this week been elected president, with Burt Van Horne secretary, treasurer and general manager. It is stated that the road will include a belt line in Lockport, and will be finished by July 1, as very little new track is needed.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD
936 Monadnock Building.
CHICAGO, Ill., May 7, 1898.

MR. J. E. KEELYN, president of the Western Telephone Construction Company, Chicago, Ill., has closed a deal for the control of the Graham Electric Company's telephone and switchboard business, as well as all of his patents. It is said this is the fifth concern that has recently been arranged for in like manner.

THE CENTRAL ELECTRIC COMPANY is now established in its new quarters at 264-270 Fifth Avenue, this city. It occupied its old quarters at 173 Adams Street for four years, but its business increased to such an extent that the space available there became inadequate and necessitated a removal to larger quarters. The building in which the company is now located has a frontage of 80 feet on Fifth Avenue and is 140 feet deep. The store and retail department extends directly back, and has shelving on both sides for the accommodation of the many lines of small supplies. To the left and across the front are the general offices and accounting departments, arranged so as to secure the most light. In the rear of the offices and to the left is a stock room in which is to be found the most complete system that can be devised for the storing and handling of the various articles required in the electrical supply trade. In this room are found nearly 1500 bins, each properly labeled and containing its distinctive specialty. All the bins are so arranged that the stockkeepers can be fully advised of the quantities of material on hand, and can assemble orders without delay. About 150 of these bins contain Okonite wires in sizes ranging from No. 8 down. In addition to the bins, ample floor space is provided for the storing of full and original packages. The shipping room occupies the entire width of the rear and opens into an alley. The basement is what the boys term a "whale." It is unusually large and high, and is equipped with luxifer prisms and all of the numerous conveniences for handling the heavy stocks which are carried. The company has its own private freight elevator. The planning of the whole establishment has been conducted with a view of quick handling of all classes of material. With its increased facilities for carrying larger stocks, the Central Electric Company expects to realize an increase in business.

ST. LOUIS NOTES.

ST. LOUIS, MO., May 6, 1898.

THE STANDARD RAILWAY EQUIPMENT COMPANY, of East St. Louis, was incorporated by the Secretary of State of Illinois, May 4, with a capital stock of $50,000. The incorporators are P. H. Murphy, C. F. Rodenberg and William F. Rodenberg.

AN INTERESTING LEGAL CONTEST.—A motion was filed in the Circuit Court May 3, asking that the receivership of the Peoples Railway be vacated and the assets of the company turned over to the Peoples Company. If the motion be sustained it will place the Green interests in control of the road for the time being.

THE PEOPLES or Fourth Street cable road and the Fourth and Arsenal Street roads may be absorbed by the Central Traction Company. A director of the latter named company is credited with saying that his company will bid for the roads when they are put up for sale, which will be as soon as the Supreme Court decides a suit between the stockholders.

THE CENTRAL TRACTION COMPANY.—The Supreme Court, at Jefferson City, last week issued a writ of quo warranto to oust the Central Traction Company from doing business in St. Louis, for alleged violation of the Julian law. The writ was made returnable within ten days, at which time the court will set a date for the hearing of the case.

CITY WIRES STILL OVERHEAD.—Officials of the Missouri-Edison Electric Company, the Missouri Electric Light & Power Company and the Edison Illuminating Company have notified the Board of Public Improvements that the city's wires now strung along poles belonging to them must come down by September 1. Otherwise it is intimated that the companies will be unable to comply with the terms of the Keyes ordinance that all poles and wires must be removed from the streets in the conduit district by January 1. The Bell Telephone Company has given the city until July 1 to remove its wires from its poles.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., May 1, 1898.

THE CASE of the Western Electric Company v. the Capital Telephone Company, of Sacramento, Cal., has been appealed to the Supreme Court since Judge De Haven's decision was made in favor of the plaintiff.

THE CITY OF SACRAMENTO, through its Trustees, has appointed a committee composed of Trustees Tibbets, Devine and Paine, to devise ways and means for securing a municipal electric lighting plant for the city.

MR. ANDREW J. COFFEE, formerly Pacific Coast representative of the United States Fire Alarm & Police Telegraph Company, is now connected with the Gamewell Fire Alarm Telegraph Company, with Mr. R. A. Rose, Pacific Coast general agent.

THE KERN-RAND COMPANY has been incorporated for the purpose of developing the water power of the Kern River, and transmitting it electrically to Randsburg, Cal., for power and lighting. Among the directors are A. A. McDonald (president), J. W. Eddy (vice-president), R. J. Walters and L. W. Goden.

THE PASADENA & LOS ANGELES ELECTRIC RAILWAY COMPANY, with all of its holdings, was recently sold to Don C. Porter, of Los Angeles, for $150,000. The purchase was made for the reorganization committee of the bondholders of the road. The company's bonded indebtedness is $350,000.

IT IS REPORTED that 500 submarine torpedoes will have been placed in San Francisco Harbor before the defenses are completed. Captain W. F. C. Hasson, formerly of the United States Navy, will have charge of the torpedo installation under Major Heuer, United States Engineers. Several skilled privates have been sent out from the Willets Point torpedo station to assist in the work.

THERE HAS BEEN for five years past very sharp competition in San Bernardino, Cal., for the supplying of electric light and power. The gas company established an electric light plant. The San Antonio Company and the San Bernardino Electric Company have been furnishing lights at prices considered about the lowest in the United States. The average price for an incandescent light was about 25 cents per month, and for each arc lamp $5 per month. All three companies have been operating plants at a loss. The result has been that the Gas Company and the San Antonio Electric Company have sold out their interests in San Bernardino to the San Bernardino Electric Company, which will make no material advance in rates. The last named company is owned by Mr. Charles R. Lloyd, of San Francisco. Some of the San Bernardino papers have advised the inhabitants to burnish up their candlesticks and to purchase oil lamps, since competition has been destroyed.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, April 27, 1898.

NATIONAL TELEPHONE COMPANY'S STAFF DINNER.—The fifth annual staff dinner of the National Telephone Company was held last Friday, and, as usual, Mr. W. E. L. Gaine, the general manager, gave some interesting statistics as to the progress of telephony during the year in this country. Ninety new exchanges have been opened, making a total of nearly 800, and 12,000 new subscribers have been connected, making up a total of 106,000 subscribers' lines in the United Kingdom. Four hundred and thirty million "effective messages" have been transmitted (that is 215,000,000 conversations), and this Mr. Gaine compares with the number of inland telegrams sent by Her Majesty's Government, which was only 73,000,000 during the year 1897. Although in Sweden the number of inhabitants per telephone is considerably smaller than in England, Mr. Gaine pointed out that this country was well ahead of most other continental countries in this respect. In Germany the population is about 52,000,000, and they have 107,000 subscribers' lines. This works out at one telephone to every 400 people, compared to one for every 300 people in Great Britain. In France this figure is 1200, in Austria 1500, in Belgium 680 and in Holland 1000. The officials of the post office, who had been invited by the National Company's staff to be their guests at the dinner, had been unable to accept the invitation owing to the fact of their being present last year having been unfavorably commented upon in some quarters.

THE COMMERCIAL SOURCES OF PURE INDIA RUBBER.—In Dr. Morris' second Cantor lecture on this subject at the Society of Arts he enumerated the various rubber producing plants, and sketched their geographical distribution. The most interesting of these plants is perhaps a semi-herbaceous one, which has only recently been discovered in Central Africa, and which covers a large part of this continent south of the Equator, being found in Benguella, Loanda and Congo. The rubber is obtained from the underground stem of the plant, the rhizome being rasped in water and coagulated by heating. Dr. Morris thinks that it might be introduced into other districts where the soil and climate are favorable, and that it would be capable of good cultivation, possibly giving an annual crop. There are two species of the plant, bearing the names "Carpodinus lanceolatus" and "Clitandra Henriquesiana." Incidentally Dr. Morris also remarked that he did not attach much importance to the sensational remarks as to the scarcity of rubber. The Central and South American rubber districts alone were in a very healthy condition, and showed absolutely no signs of a diminution of output. There are also many districts in Africa which have hardly been worked at all. He also pointed out that some plants were particularly suitable for cultivation, especially the "Heva," which produces the Para rubber, the Central American "Castilloa elastica," the "Kickxia" and the semi-herbaceous plant mentioned above.

General News.

THE TELEGRAPH AND TELEPHONE.

PLAINFIELD, N. J.—The New York & New Jersey Telephone Company is laying underground wires in Plainfield.

AUSTIN, N. Y.—The Village Board has granted to Austin Devoe, of this place, a franchise to build and operate a local telephone exchange.

GENEVA, ILL.—The DeKalb County Telephone Company has been granted a franchise in DeKalb to construct and operate a telephone exchange in that place.

FREDERICKSBURG, VA.—The Orange Telephone Company, whose lines extend from Parkers in this county to Orange Courthouse, has declared a dividend of 13 per cent.

MARSHALL, MINN.—The Northwestern Telephone Company has commenced the work of building a line from St. Peter to Tracy, and probably will extend it to Marshall.

EAST RUTHERFORD, N. J.—The Bergen County Telephone Company has asked for a franchise in Rutherford and East Rutherford to establish a telephone system between the two places.

STILLWATER, MINN.—A franchise has been granted to Otis Staples, James Mulvey and R. H. Bronson to construct and maintain a telephone line. The franchise is for a period of fifteen years.

SHELBYVILLE, IND.—The Bell Telephone Company has given notice that after May 1 it will charge no rental for its 'phones. This step is supposed to be for the purpose of heading off competition.

PRINCE FREDERICKTOWN, MD.—The directors of the Baltimore & Brown Point Telephone Company have decided to begin at once the construction of a line from Annapolis, south to Solomon's Island, opposite Drum Point.

PEN ARGYL, PA.—The Slate Belt Telephone Company has extended its line to Ross Common, Saylorsville, Mechanicsville and Effort, in Monroe County. Plans are now being made to extend the line to Wilkesbarre, including several places on the way.

WABASH, IND.—The Bell Telephone Company has established free service on its toll line between Goshen and Elkhart. The service is available by the company's regular subscribers, and is said to be made to discourage the enterprise of the new Goshen Telephone Company, which is soliciting subscribers.

LA PORTE, IND.—The La Porte Telephone Company has recently changed its system from an automatic to a manual switchboard, putting in a 300-line S-C rapid operating board. This change gave it considerable line construction not required for the same number of stations, but which is rapidly put to use for the many new subscribers now coming in.

TRENTON, N. J.—Within the past few days the John A. Roebling's Sons Company, Trenton, N. J., has completed a large submarine cable for the Western Union Telegraph Company, to be used for the transmission of messages beneath the waters of Puget Sound, between Port Angeles and Victoria. The cable is 29 miles in length, and has but a single splice in its whole extent. One section is 20 miles in length and the other nine, the former requiring six cars, each of 60,000 pounds' capacity, and the latter three cars of like capacity, for their transportation. The cable was laid on the cars in the shape of a large figure eight, layer upon layer, and upright boards were placed along the sides of the cars to give them greater capacity. A temporary roof was built over the cable. The entire cable weighs 421,080 pounds, and it was made at the rate of about a mile a day. During its construction the electrical engineer of the Western Union Telegraph Company was on the ground to watch the work and make measurements from time to time. The very best of gutta percha was used for insulating the three conductors which the cable contains. The cable is now on its way to Puget Sound in charge of two men. The Roeblings Company is now at work on some submarine cables for the Government, about 28 miles in all.

HARRISBURG, PA.—The Pennsylvania Telephone Company has accepted the terms of the ordinance giving it permission to construct, maintain and

operate underground telephone wire conduits in the city. The work is to be conducted under the supervision of the city engineer and the highway commissioner.

BEAUFORT, N. C.—The Government has let a contract to build telephone lines between this place and the Cape Lookout life-saving station and lighthouse, a distance of 20 miles. A line will connect Cape Lookout with Portsmouth station, and from there it will run to Ocracoke, and thence to Hatteras to connect there with the Norfolk telegraph line.

OGDEN, UTAH.—It is stated that there is a scheme on foot among Ogden capitalists to establish a telephone system throughout the State of Utah. It was originally intended to confine its work to this city, but it is now reported the company's plans will embrace the entire State. Among those interested are David Eccles, John Scowcroft, H. H. Spencer, Thomas D. Dee and George H. Mattson.

CARO, MICH.—Mr. W. J. Moore, proprietor of a large number of independent telephone lines and exchanges in the "thumb" of Michigan, has just closed two contracts, one with the Detroit Telephone Company and another with the Valley Telephone Company, and will connect with their lines and exchanges. With these three systems in joint operation South Michigan, it is stated, will have a telephone service second to none.

BAY CITY, MICH.—The Valley Telephone Company has substantially completed its underground work in Bay City, West Bay City and Saginaw. Its cables under the river at Bay City and Saginaw are laid and ready for operation. The exchanges in Flint and West Bay City are in full operation, and the switchboards for Bay City and Saginaw, East and West Sides, are nearing completion. The line from Saginaw to Flint is almost finished. The Valley Company, it is stated, will start out with more than 2000 subscribers.

Electric Light and Power.

CAMDEN, N. J.—The Stockton Electric Light Company has accepted the terms of the ordinance granting a franchise to put in a plant.

NEW YORK CITY.—The camp at Peekskill is lighted by electricity. The Peekskill Electric Light & Power Company laid the necessary cables, etc., across the creek.

MIDDLETOWN, N. Y.—The Citizens Electric Light & Power Company has contracted with the Hogan Boiler Company for two boilers, each of 150 horse-power, for use in the new plant.

HARRIMAN, TENN.—The City Council has awarded the contract for the incandescent light equipment. The Westinghouse Company was given the contract for dynamos and switchboard for $1697.

FLUSHING, L. I.—The New York & Queens Light & Power Company announces a reduction of 25 per cent. in the prices heretofore charged for electric lighting in Flushing, College Point and Whitestone.

MATTOON, ILL.—Mattoon is probably the most thoroughly lighted city of its size in the United States. There are three distinct lighting plants established, including the city plant, owned and operated by the municipality.

FORT WAYNE, IND.—The Jenney Electric Light & Power Company has awarded to the National Conduit & Cable Company, New York, the work of placing its Calhoun Street wires underground. The cost will be about $25,000.

INDIAN ORCHARD, MASS.—The Indian Orchard Company will build a large power house and equip it with modern electrical machinery. Beside running its own mills and supplying its tenants, it will have a large surplus of power for the use of new industries.

BRATTLEBORO, VT.—A proposition to buy a water power at Fairfax, 9 miles away, and bring the electrical power to St. Albans, is being considered. It means an outlay of $125,000. Boston men are behind the scheme, and an option has been secured on the property.

SPRINGFIELD, MASS.—The contract for building the new power plant for the Central Massachusetts Electric Company in place of that recently burnt at Palmer, has been awarded to the Flint Building & Construction Company. The new building will be fireproof.

RALEIGH, N. C.—The Yadkin River Electric Power Company, just inaugurated, operates Fries' woolen, cotton and flouring mills, the South side cotton factory, the street railway, the electric lighting plant and Fogle's planing mill. It is the only concern of the kind in the State.

RICHMOND, IND.—Anderson's municipal electric light plant has been paying so well that a reduction in prices has been ordered. Arc lights to consumers on the six-day circuit will cost $4.35 per month; seven-day circuit, $5. The reduction is about 13½ per cent. Incandescents will be reduced in the near future.

PROVIDENCE, R. I.—The plant of the American Electrical Works is running overtime getting out wire cable for the United States Government. It is understood that the cables are to be used with submarine mines. President E. F. Phillips says that the contract received by the company was very large, but that it was being filled satisfactorily to the Government.

DUNKIRK, N. Y.—The water board has fixed the rates for commercial electrical lighting as follows: For business houses, ten or more 16-cp incandescents, 25 cents per month, less than ten lamps at special rates; single arc light, $36 per year; for two or more, $33 each. Lamps run more than six hours pay meter rates (8 cents per 1000 watts) for excess. Hotels with fifty or more lights are allowed 30 per cent. discount. For dwellings the minimum charge for one lamp per month will be 10 cents upon six hours' basis. The rates were established after careful computation of entire cost of production.

The Electric Railway.

SANDY HILL, N. Y.—The electric railroad will hereafter run through express cars from Glens Falls to Sandy Hill and Fort Edward.

CHESTER, PA.—Isaac A. Walker & Son, the contractors, have completed the electric railway at Meadville. It is over 10 miles in length.

UTICA, N. Y.—The Utica Suburban Railway has received a franchise allowing it to extend its tracks to the cemeteries and Glen Park. Work will begin at once.

NEW YORK CITY.—A Boston syndicate has purchased the Manchester, N. H., street railway, which has a capital stock of $170,000 and $250,000 bonds. The road is 20 miles long.

SPRINGFIELD, MASS.—The Springfield Street Railway Company has received authority from the Railroad Commissioners to issue new stock to the value of $291,700, at $200 per share.

SYRACUSE, N. Y.—The village of Baldwinsville has granted a franchise to the Onondaga Lake Railway Company. One feature of the franchise is that the company is required to pay the village $1500.

BROCKTON, MASS.—The directors of the New Bedford, Middleboro & Brockton Street Railway have accepted the franchises granted by Middleboro, Bridgewater, Lakeville and Freetown. New Bedford will grant a franchise this week or next.

HUDSON, N. Y.—The Greene County Traction Company has completed negotiations for the construction of the first 5 miles of the Coxsackie & Middleburg Electric Railway. Part of the supplies have been purchased, and work begins at once.

BUFFALO, N. Y.—George P. Smith has not paid the village of Tonawanda the $4200 back tax, although the time for so doing has expired, and it is understood the village attorney will at once institute proceedings to annul his electric railway franchise.

DOYLESTOWN, PA.—A new trolley enterprise is about to be launched. An engineer corps is making a survey from Doylestown to Newtown, by way of the Bush, Forest Grove, over the Pebble Hill road. A good company backs the enterprise.

STROUDSBURG, PA.—From the tone of the East Stroudsburg Council meeting held recently, it was seen that the members were in favor of the electric railway, and will pass the needed ordinance. There is some little hitch about the exact route.

LONACONING, MD.—The franchises granted to the electric railway company by the County Commissioners have been signed and accepted by the officials. Work will be commenced at an early day; the track from Narrows Park to Allegany Grove will be first laid.

WORCESTER, MASS.—Two electric street railway companies have organized to build a railway through Upton, one with a capital of $80,000 and the other with $200,000. The first named is practically the Attleboro & Milford Company. They both want the same route.

Legal Note.

ELECTRIC SMELTING APPARATUS—Priority of invention in the art of heating conducting bodies by an electric current established between them and an electrolytic bath through an arc across a gaseous resistance sheath has been declared in favor of Mr. George D. Burton, of the Burton Electric Smelting Company, of Boston, by the Examiner of Interferences of the Patent Office. There were three parties in this interference, the applications of the other two having been filed two and four years respectively previous to that of Mr. Burton; but the record of the latter was adjudged to disclose that in the year 1883, when experimenting with an electric lamp designed for submarine purposes, the inventor accidentally discovered this possible means of heating conductors and thereby obtained a date for the conception of the invention in that year.

Personal Notes.

MESSRS. H. J. MEDBERY, president and general manager, and George W. Wait, treasurer of the Warren-Medbery Company, Sandy Hill, N. Y., were in New York last week visiting the Electrical Exhibition.

LIEUT. W. F. C. HASSON, the well-known electrical engineer and expert of San Francisco, has shown his patriotism by working for the Government gratuitously in laying mines in San Francisco harbor and in building the electrical connections.

MR. EDWARD LIVINGSTON MORSE, son of the late Prof. S. F. B. Morse, the inventor of the American telegraph, and an artist, was entertained on May 2 at luncheon at the home of his cousin, in Baltimore, Mr. A. G. Davis, president of the Viaduct Manufacturing Company, of that city. Mr. Morse is a resident of Washington, to which city he recently removed. His mother resides with him.

Trade and Miscellaneous Publications.

THE GRAY TELEPHONE PAY STATION COMPANY, Hartford, Conn., which manufactures automatic pay station telephone instruments, describes and illustrates its various styles of apparatus in a neat catalogue, made in the shape of the familiar long distance bell sign. All styles of telephones are made with the automatic feature. This instrument collects accurately all tolls for telephone service. The money drawers are of iron, and are securely bolted into the boxes. The stations are neat in appearance, accurate in their workings, simple but durable in construction and are fully protected by patents. Nearly all of the telephone companies are using numbers of them with satisfaction and profit.

Removal Notices.

MR. WILLIAM MAVER, JR., electrical engineer, has removed his office to the Beard Building, 120 Liberty Street, New York.

MESSRS. ALBERT FRANK & CO., general advertising agents, have removed to the Empire Building, corner Broadway and Rector Street, New York.

Trade and Industrial Notes.

THE WARREN-MEDBERY COMPANY, Sandy Hill, N. Y., is installing a 150-kw improved Warren inductor alternator in the power house of the Ballston Electric Light & Power Company, Ballston Spa, N. Y.

MESSRS. GILLINDER & SONS, Incorporated, of the Franklin Flint Glass Works, Oxford and Howard Streets, Philadelphia, Pa., whose works were recently damaged by fire, announce that they are again running on full time and are prepared to fill orders promptly.

THE FOREIGN MARKET for American electrical machinery seems to be opening up in a very satisfactory manner. The Sprague Electric Company has recently shipped several direct-connected generating sets for isolated lighting plants, as well as a large number of Lundell fan motors, to India and Japan.

THE SPRAGUE ELECTRIC COMPANY has just received a contract for seven worm-gear drum elevator machines for the Government Printing Office at Washington, D. C. A significant fact is that one machine of this type was ordered two years ago, and the satisfactory service that it gave led to the second order noted above.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has sold to the Citizens Street Railway Company, of Indianapolis, a 500-kw, 90 r. p. m., machine of the Westinghouse standard type. The machine is direct connected to an Allis-Corliss engine. It is over-compounded 10 per cent., the normal potential being 550 volts.

MR. CHARLES E. GREGORY, 313-317 South Canal Street, Chicago, has signed a contract with the city of Chicago to make for it 1100 ten-ampere arc lamps, with hanger arms and hoods complete. These lamps are being made under C. A. Pfluger's patents at the works of the Standard Electric Company, which Mr. Gregory has leased for the purpose.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is building two three-phase belt driven generators, 500 horse-power each, 3000 alternations, 2400 volts, for the Canadian Niagara Power Company, at Niagara Falls. The success of the 5000-hp machines built for the Cataract Construction Company has encouraged others to enter the field for harnessing Niagara.

THE JANDUS COMPANY, Cleveland, Ohio, is having a lively demand for its Jandus enclosed alternating arc lamp. The lamp burns on the same circuit with incandescent lamps, singly, steadily and without noise. Its efficiency is said to be 95 per cent. In Chicago the office of the company is located at 753 Monadnock Building, and price lists may be obtained on application,

THE PAXTON HOTEL, Omaha, Neb., is putting in an electric light plant, the power for which will be supplied by a Ball & Wood engine, built by the Ball Engine Company, Erie, Pa. A direct-connected electric light plant is being placed in the Exchange Building, Boston, Mass. The engine is supplied by the Ball Engine Company, and the dynamo by the Westinghouse Electric & Manufacturing Company.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, is manufacturing a porous cup which is known to the trade as No. 6. The materials used are the very best, all being carefully examined and tested. The cup is homogeneous and thoroughly porous, and the manganese and carbon are of the purest obtainable. The recuperative power of a battery using these cells is said to be very rapid.

MESSRS. CHARLES A. SCHIEREN & CO., No. 47 Ferry Street, New York, have just made a shipment of leather belting to the Pacific Beet Sugar Company, at Hueneme, Cal., of 550 feet of leather belting, all double sizes, running from 4 inches in width to 64 inches in width, the total net weight of the shipment being 9419 pounds. This is one of the largest shipments of leather belting ever sent out of New York.

MESSRS. G. M. ANGIER & CO., Boston, Mass., announce that they are now ready to place upon the market their new enclosed Paragon short lamps for constant potential, 90 to 125 volt circuits. This lamp is a departure from existing types, and the tests already made are said to have proven so satisfactory that the lamps should meet with instant recognition and approval from users of arc lamps in general.

THE EMPLOYEES of the Western Electric Company, New York, have formed a bicycle club, for the purpose of taking runs every Saturday afternoon. It is their intention to go to a different place each Saturday. The first run took place on April 30, to Coney Island. It was attended by 75 per cent. of the members, and was a very successful outing. The club has a membership of fifty. It is named the W. E. Bicycle Club.

THE ELECTRICAL EXCHANGE, Chicago, reports meeting with great success with the "Midget" Upton arc lamp, for which it is the agent. It has already secured orders for a large number of the lamps from all parts of the country. One shipment was to St. Michael's, Alaska. In addition to the regular line of "Midget" Upton lamps the Exchange is putting out a new "Midget" Upton alternating lamp, which is meeting with great success. The Exchange carries a full line of "Midget" Upton lamps in stock at Chicago.

"THE GALVANO PLASTIC," a well-known firm of electrotypers and stereotypers in Berlin, Germany, has recently been fitted out by F. Wesel & Co., of New York City, with an up-to-date plant. Every machine run by power has its own separate Lundell electric motor, the motors having been supplied by the Sprague Electric Company, New York. It is said that this is the first and only plant of this description in the world at the present time operated in this way, and it will no doubt attract a great deal of attention here as well as abroad.

THE BALTIMORE SECURITY & TRADE COMPANY, Baltimore, Md., offers for sale at bargains the machinery and materials bought for the Columbia & Maryland Railway. The material includes copper bonds, manufactured by the Benedict & Burnham Manufacturing Company; 7633 tons of rails, ten 300-hp Zell improved water-tube boilers, pumps, fuel economizers, stacks, etc. The company solicits correspondence or personal inspection looking to the sale of this machinery and materials, all of which are practically new, never having been usd.

THE MAGNOLIA METAL COMPANY, New York, N. Y., writes that an injunction has been granted by Judge Wallace in the United States Circuit Court of New York in favor of that company. The injunction, which is permanent, is against B. Lowenstein & Brother, trading as the Nassau Smelting & Refining Company, New York, restraining them from offering for sale and advertising "Magnolia anti-friction metal," which, it is stated, they were advertising and selling as "Magnolia anti-friction metal." This, the Magnolia Metal Company asserts, is calculated to deceive the public.

SNOWPLOW MOTORS.—Two Westinghouse 12-A 25-hp motors were placed on the heavy Taunton snowplows of the Milford, Holliston & Springfield (Mass.) Railway early in the winter. The superintendent of the railway, Mr. G. B. Larrabee, reports that during a very severe winter, in which the heaviest storms were encountered that have occurred for several years, the motors never caused a stoppage nor suffered a burn out. During the heaviest storm the motors were only normally warm. These motors were of the ordinary standard Westinghouse type, and considering the severe service they have made a very good showing.

IN THE LAST ISSUE of THE ELECTRICAL WORLD reference was made on the authority of the Fischer Foundry & Machine Company to a decision in that company's favor in a controversy between it and the Weston Engine Company, of Painted Post, N. Y. The latter company writes that the acting examiner who rendered the decision has since admitted that he had some doubts in the matter, and further consulted others. This, the Weston Company asserts, renders the decision void, and an appeal has been granted, the hearing to occur on June 17 next. The "Imperial" engine, the Weston Company states, is covered by many patents, and the company is confident that at the next hearing it will be able to have the decision reversed.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has lately issued a small card which it encloses in all letters to machine builders and factory owners. On one side is displayed a cut of one of its motors operating a 72-in. Gray planer. The motor is of small size, and is placed on top of the planer, allowing a traveling crane to pass over it. The shaft of the motor is coupled direct to the main driving shaft of the planer. The motor is shunt wound to give constant speed under varying loads, and has a capacity of 12 horse-power. On the other side of the card is a short description of the arrangement of motors on machine tools and the advantages to be derived from this mode of supplying power. The card is printed in two colors, and makes a neat enclosure for letters.

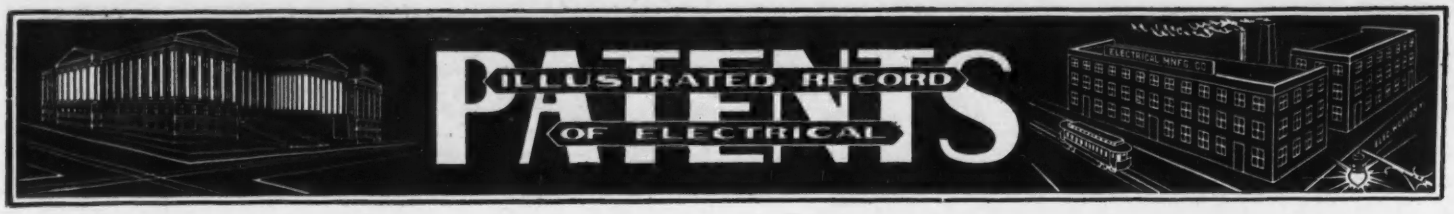
CREDITABLE SHOWING IN STREET RAILWAY MOTORS.—Seventy-six double equipments of Type 49, 35-hp motors have been ordered from the Westinghouse Electric & Manufacturing Company by the Cleveland Electric Street Railway Company. Mr. Charles H. Smith, superintendent of the Lebanon & Annville (Pa.) Street Railway Company, writes: "On June 20, 1895, one of the Westinghouse 12-A 30-hp equipments was put into service on this road. Since that time it has made 592 days, 200 miles per day, a total mileage of 118,400, without a single repair to any part of the machine, save renewal of brushes and bearings. The motors were put under a Jackson & Sharp 30-foot closed body car, running over the hardest part of the road, with less than five minutes' lay-over at either terminus, from 6 A. M. to 12 midnight. Wish all our equipments were Westinghouse 12-A."

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY, Chicago, Ill., whose factory was totally destroyed by fire on January 28 last, is now in better condition than ever before for filling orders for its tested fuse wire and links. This company calls attention to the fact that after May 1 all its fuse wire will be packed on the trade-mark spools which it has used for the past five years, and that these spools will be inserted in neat individual tin boxes, which will protect the wire from abrasion and also from being affected by changes of temperature. The company will carry a full stock of all sizes of wire, strip, links, telephone and telegraph fuses, and will make shipments from its factory in Chicago or its Eastern office at 853 Broadway, New York City, as may be most convenient to the trade. Manager W. R. Goodman says the great consideration shown the company by all its friends in the trade during a few weeks of enforced suspension of business after the fire is highly appreciated.

THE MANUFACTURER of the Upton midget enclosed arc lamps, recognizing the fact that many plants using enclosed arc lamps for alternating current, which at the present time are operated on the high frequency, may desire to change over to the low frequency current at no distant day, has so designed its lamp that it will operate on both frequencies without change of adjustment. When called for by customers the lamp is furnished so that the only change required is in the terminal connection on the lamp in the binding posts, which are properly marked. The lamps can be adjusted to take from four to six and one-half amperes, as may be desired; that is an average consumption of from 300 to 500 watts per hour. The Standard Thermometer & Electric Company is also prepared to equip each lamp with a reflector over the arc, and an opal shade in place of an outer globe. The Standard people claim that the sales of their lamp are increasing every day in volume, and that flattering reports are received from users all over the country as to its steady burning and noiseless operation. They also report that their enclosed arc series lamp for constant current circuits of from four to seven amperes is giving excellent satisfaction. Large numbers of them are being sold for commercial lighting, and also for street service. Among recent sales for street lighting they mention the municipal lighting plants at Taunton and Hudson, Mass.; the Tecumseh Electric Light Company, Tecumseh, Mich.; Fox River Lighting Company, Green Bay, Wis.; Oshkosh Gas Lighting Company, Oshkosh, Wis., all of whom made their purchases after thorough tests in comparison with other lamps. The Standard people have recently issued a new catalogue, which gives full description and cuts of their enclosed arc lamps for all circuits. Copies of this catalogue will be mailed on application to the home office at Peabody, Mass., or any of their branch offices.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED MAY 3, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

603,279. AUTOMATIC ELECTRIC FIRE ALARM; W. E. Frost, Lewiston, Me. App. filed June 30, 1897. In an automatic electric fire alarm in combination a shell or case having an air chamber and a concave or sunken drumhead or diaphragm, a movable float circuit closer arranged centrally within said case or shell and loosely supported on said diaphragm, a stationary electrode metallically connected to said case or shell and circuit wires connected respectively to said electrode and float circuit closer.

603,283. ELECTRIC ARC LAMP; T. H. Pettengill, Amsterdam, N. Y. App. filed Sept. 7, 1897. In an arc lamp, the combination with the coarse and fine wire coils, the starting coil, bridge contacts and circuit connections, of the armature lever, an insulated cut-out contact carried thereby, a circuit connection from said contact to the terminal of the coarse coil adjacent to the bridge contacts, and a short circuiting contact against which the first named contact is drawn when the armature lever is brought to its lowest position.

603,334. ELECTRICAL ATTACHMENT FOR GASLIGHTS; F. L. Kellner and G. S. Barrows, Philadelphia, Pa. App. filed Nov. 22, 1897. An attachment for Welsbach and other gaslights, comprising the combination of a gas admission valve and its complemental seat respectively provided with gasways and adapted to be lifted and turned in respect to each other, a zig-zag groove and its complemental pin for effecting rotation of the valve to position, said gasways for the admission and exclusion of gas, and electromagnets and their armatures and connections for lifting and dropping the valve, whereby it is rotated with a step-by-step motion in the same direction, and lifted and dropped at each rotation.

603,301. PROCESS OF MAKING PEROXIDE OF LEAD FOR GALVANIC BATTERIES; J. D. Darling, Philadelphia, Pa. App. filed Dec. 23, 1896. A process which consists in compressing a mass of peroxide of lead containing free acid, and then exposing said mass to electrolytic action as a cathode in a neutral electrolyte until the superficial layer of the mass has been rendered coherent by the production of inherently formed binding material.

603,369. ELECTRIC SIGNAL SYSTEM; L. C. Werner, Broad Brook, Conn. App. filed June 12, 1897. This invention relates to electric signal systems, and more particularly to a system for indicating to a vehicle or train moving along a line of way its position relatively to a distant point on the same track, and especially the distance between it and the nearest vehicle on such track.

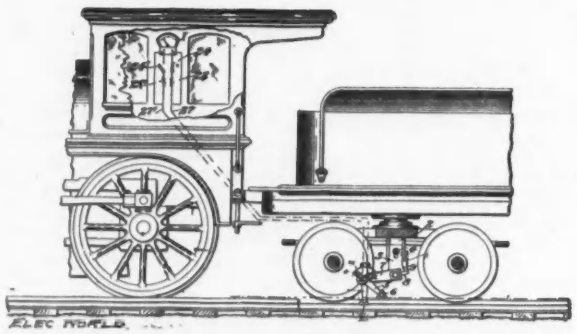
603,383. ELECTRIC ARC LAMP; A. W. Knutson, Galesburg, Ill. App. filed April 30, 1897. A clutch for electric arc lamps having a clutch arm formed with an obliquely disposed rod opening piercing one side of the arm to permit of the carbon rod passing laterally into said opening, one of the inclined walls of said opening being provided with a clutch notch.

603,390. ELECTRIC SIGNAL SYSTEM; L. C. Werner, Broad Brook, Conn. App. filed June 17, 1897. Improvement on No. 603,361.

603,499. ART OF MAKING PLATES FOR ELECTRIC BATTERY PURPOSES; A. C. Croftan, Chicago, Ill. App. filed Feb. 5, 1897. An improved method of forming spongy lead plates, which consists in forcing molten lead through a series of small orifices and allowing it to pile up just before solidifying upon a horizontally vibrating surface.

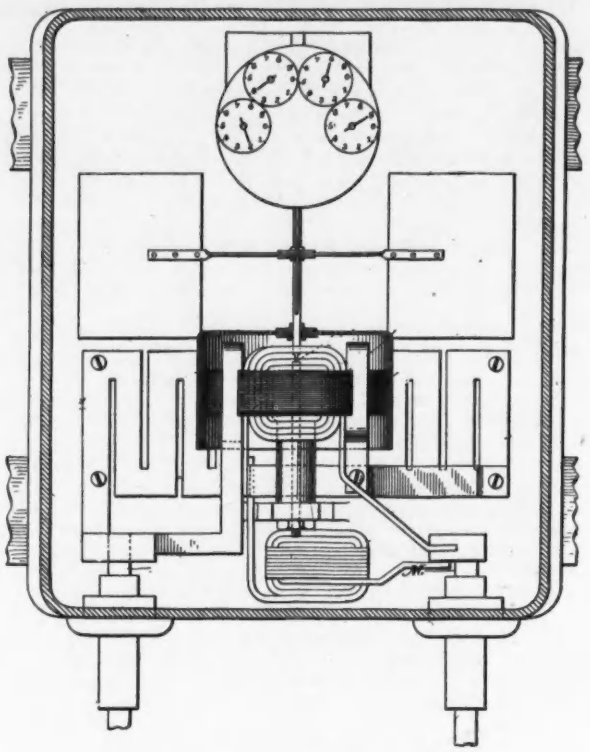
603,515. ELECTRICAL APPARATUS; W. Stanley, Pittsfield, Mass. App. filed Jan. 28, 1897. In an electrical apparatus, two coils in series with each other and with a source of alternating current, in combination with two shunts, one of less, the other of greater time constant than the coils which they respectively shunt, and a closed circuited armature in direct inductive relation to the fluxes produced by both coils.

603,524. ELECTRIC DENTAL ENGINE CONTROLLER; J. J. Coachman, Rio Janeiro, Brazil. App. filed Aug. 21, 1897. A controlling device for an electric motor, comprising in connection with an electric circuit a series of contact strips, a pedal movable over the same and carrying contacts, a resistance coil, a contact point carried by the pedal for engaging with the resistance coil and a pole changer electrically operated.



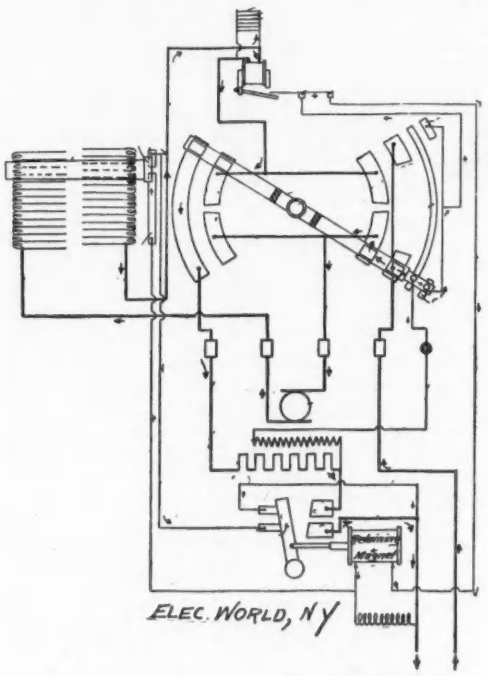
No. 603,369.—Electrical Signal System.

603,594. TIME LIMIT CUT-OUT; H. H. Cutler, Chicago, Ill. App. filed July 26, 1897. In combination, the active coil of a cut-out and a time limit controlling the same, and comprising a section of an electric circuit, the resistance of which varies with rise of temperature due to the current.



No. 603,515. –Electrical Apparatus.

603,606. ELECTRIC CONVEYING SYSTEM; A. S. Krotz, Springfield, Ohio. App. filed Dec. 2, 1897. The combination of a battery or other source of electrical supply, track conductors, one connected with one pole of the latter, a plurality of terminals stationed along a continuous stretch of the other track conductor, and all connected with the other pole of the battery and automatically opening circuit closers to connect said terminals respectively with said latter track conductor.



No. 603,594.—Time Limit Cut-out.